THURSDAY, JANUARY 19, 1899.

THE ANATOMY OF THE EARTH'S CRUST.

Earth Sculpture; or, the Origin of Land Forms. By James Geikie, LL.D., D.C.L., F.R.S. Pp. xvi + 320. (London: John Murray, 1898.)

THE sculptor must be careful to mould his drapery so that its fall and fold may accord with the form below; or, if he copies the undraped human form divine, however quick his eye to detect and his hand to represent, if he wishes to follow the curves of beauty with ease and accuracy he must know the position and functions of the muscles and bones upon which the outlines and pose of the body depend.

So in the study of scenery we shall be better able to appreciate the forms presented to us if we understand the causes which have determined them; then we shall look with different eyes on the gently rounded outlines where soft surface-drifts like drapery have clothed the solid rocks, filled up their hollows, and concealed their ruggedness. Still more shall we have the pleasures of imagination heightened when we can, from an examination of the surface, realise the "ribs of porphyry" or the "joints of the limestone" that have determined the configuration and lie of the land before us.

A very useful work for the sculptor would be "Outlines of Human Anatomy for Artists, with Dissections"; but that would not be a work on sculpture; and the book before us might not inappropriately have been called "The Morphology and Physiology of the Earth's Crust, with Sections; being an Introduction to the Study of Earth Sculpture and its resultant Scenic Features." For it includes far more than its title would imply. It is, in fact, a series of essays upon the principles of geology, in which the author keeps in view the question which on his title he has proposed for consideration; and, at the same time, gives great prominence to those aspects of the subject which bear upon certain theories towards the development and promulgation of which he has taken a leading and distinguished part.

He points out that subterranean action merely provides the rough block which the surface agents of denudation subsequently sculpture into shape, and that, with few exceptions, the land features that now meet our eye are the direct result of erosion and accumulation, the modifying influence of which is always more or less conspicuous.

As the work is intended for readers not skilled in geology, the author has not thought it necessary to burden the pages with references, which for the student are indispensable. He has adopted the *a priori* method; and a great part of the work is devoted to explaining what might, could, would, or should be, assuming the prevalence of certain conditions.

The readjustments of a hardening crust to a shrinking nucleus are referred to as sufficient cause of the foldings which have lifted large areas within reach of earth sculpture, and produced the crumplings and great variety of structure observed in many mountain chains. Perhaps mention might have been made of other theories to account for crustal movements, such as the loading of off-shore areas by sediment, and the corresponding lightening of the adjoining areas from which that sediment was derived; the theories of subterranean lakes of molten matter; the changes of volume which accompany chemical, mineralogical, thermal and other changes in the rocks, and so on.

When looking at the subject from the point of view of earth sculpture, the most important point is the more or less yielding character of the rock—whether this be due to its chemical composition as shown in the manner in which a limestone is dissolved, and rocks with potash felspars crumble away; or whether we regard its texture and structure as shown in the manner in which a shale often resists denudation, while a tough massive rock breaks along joints and bedding planes, and is thus readily cut back; or in its relation to the lie of the rocks as shown in the way in which they resist denudation better where they present solid bed-faces to the weather, than where the denuding agents can attack them along the lines of weakness between the divisional planes. Among beds which are horizontal, or only slightly and uniformly inclined over large areas, there will be a greater similarity in the resultant features than there can be if the beds are thrown into sharp folds, so that rapid alternations of rocks of different solubility, hardness, &c., are exposed in ever-varying positions within short distances. These points chiefly are elaborated in the first nine chapters.

Then we have two chapters on the modification of land forms by glacial agency. The work of ice at the present time is described and the traces of similar work in the past, over areas from which the ice has long been removed, are sketched out. It does not, however, necessarily follow that it was more generally extended over either hemisphere. We shall sufficiently account for all the phenomena observed if we admit that the scene of its severest operations has been shifted from time to time.

Among the controverted questions relating to the origin of glacial accumulations is that of the mode of formation of the ground moraine, that is the great mass of clay and rock which is found at the base of the ice, and of which relics are left plastered over the surface of many glaciated regions.

Have the larger fragments, at any rate, worked their way down from moraines and from the sides to the bottom of the ice, where, crushed against one another and driven over the underlying rock, they produce the clay which forms the matrix of the ground moraine and the "flour of rock" which discolours glacial streams? Or is the ground moraine derived chiefly from the rock over which the ice is travelling; does little material reach the bottom of the glacier or ice-sheet from its surface; and has the ice the power of extracting pieces of rock from its bed, and using them as tools to plough up or grind away more?

This last is the view which our author favours, but it involves the concession that some rock fragments mus have got in from above to start the work, as ice, like water in this respect, has practically little eroding power, but moulds itself round obstructions and only operates in denudation as a handle or back to hold the fragments of rock which form the rasp that really does the work.

Many interesting examples are cited of pieces of rock

which appear to have been gouged out of the bed of the glacier stream, but they are all within the range of the minor advances and recessions of the ice, and still leave room for doubt in the minds of those who are inclined to the view that most of the large fragments in the ground moraine have got in from above.

The author has long been engaged in controversy on the causes and mode of operation of glacial agents, and has, as is well known, pronounced views upon the subject; but in a work of this kind we might have expected to find not merely those facts stated which support the author's theories. Yet we look in vain for a sketch of the work of icebergs, floe-bergs, shore-ice, pack-ice, &c., in handing on and distributing material from the higher ground over wide submarine areas.

We can hardly ignore the potent agency of ice-masses, such as that seen by Ross and Parry, and estimated at 1,500,000,000 tons weight, in modifying the surface of the land on which they grounded, and against which they were driven by wind and current with a velocity far greater than that attained by any glacier or ice-sheet.

Icebergs, 700 or 800 feet high, have been seen sailing along off Cape Horn, and we know that the volume of ice below the water would be between eight and nine times that seen above it. Not only must we take account of the tremendous momentum of this stranding ice, but the enormous quantity of débris now carried by floating ice and distributed over the sea-bottom would seem to deserve some notice. The fact calls for some explanation, if it be a fact, that nothing of the kind is recognised among the glacial deposits as having been raised from the sea-bed within reach of observation.

Towards the end of the work, where he is developing a classification of forms, our author gives a separate chapter on coast-lines and another on basins, which last is very much a continuation of the chapters on glacial phenomena. He accepts the glacial origin of most rock basins, though he admits that there are difficulties in reconciling this view with some of the phenomena observed in the outer Hebrides, for instance (pp. 242–244).

He describes the loess of Southern and South-eastern Russia as primarily a flood-loam of glacial times, and considers that much of that occurring in the river valleys of Central Europe has been derived from Alpine lands (p. 192). But anyone who has examined the character and mode of occurrence of the black, dusty Tchernosem of Southern Russia, covering all the surface high and low, continually blown away and washed away and ever renewed, will have his confidence in those wide generalisations as to the origin of all loess considerably shaken.

England is the country of all countries for the study of the fossiliferous rocks; America is too broad, Switzerland too high; in England the evidence is fairly complete within easy distances, and is generally accessible. So it is in Scotland that we find the most readily available epitome of the phenomena of rock-structure. It is, therefore, to be regretted that a larger portion of the illustrations were not taken from actual sections seen in Scotland or England. The work would have been more valuable if the facts could have been verified in the field in a summer's trip. As it is there are only a dozen Scotch sections, including the two excellent photographs of weathered granite, and a couple from England, while thirty-five of those of which the locality is given are taken from foreign works. The remaining forty-two have no locality—that is, are only diagrams, and those not very satisfactory.

If the glossary was intended to be confined to words used in this work, there are not many which it would not have been better to have explained or paraphrased in the text, and most of them need no further explanation than should be gained from the context; while some need not have been used at all, for it is not easy to state a case in which anything is gained by using epigene and hypogene instead of above-ground and under-ground. Of those that do seem to require a note, some—for instance, "tectonic"—are not mentioned in the glossary. But if it is a general glossary to assist those who might wish to follow up the line of inquiry by reading special memoirs, the information is not wide enough. It might have been helpful to have enabled the reader to discriminate between diorite and syenite, dolerite and basalt, and so on; and, if the origin of the word is explained, to point out that diorite was so named from the ease with which the component minerals could be distinguished as compared with dolerite which was obscure, although such rough distinctions were not those upon which modern petrologists rely for their classification.

However, after cautioning our readers that there are other interpretations of many of the facts observed, besides those offered in this work, and pointing out some slips which will probably be corrected in the next edition, we can recommend them to read this able and clearly arranged succession of essays upon an interesting group of natural phenomena.

THE OASIS OF SÎWAH.

From Sphinx to Oracle. By A. Silva White. Pp. xvi + 277. 2 Maps, and 57 Illustrations. (Hurst and Blackett, 1899.)

UNDER a somewhat fantastic title Mr. A. Silva White has published an account of a journey which he made in the early part of the present year to the Oasis of Sîwah, the Oasis that was made for ever famous by Alexander the Great, who visited it after he had conquered Phœnicia and Egypt. Mr. White's visit seems to have been prompted by an inspiration which came upon him after he had drunk deep of the "sonorous silence" of the desert, at "midnight hours," "in the radiance of a full-moon." We wish that the inspiration had been a thing born of the day, and that it had counselled him to persevere in making preparations which took the form of studying the history and languages, ancient and modern, of the land over which he had resolved to travel. His original object seems to have been to visit Jarabub, the stronghold of the powerful "Senussi" sect of Muhammadans, which lies rather more than one hundred miles from Sîwah, in a direction more west than north. As Mr. White talks of his "political studies" we may assume that he had some definite mission when he set out for this uninviting spot; we have no right to inquire what the mission was, and we can only offer him our sympathy in his failure to reach the place where he fain would have been. To this failure we perhaps owe the appearance of his work.

The Oasis of Sîwah has within the last century been visited by W. G. Browne, Hornemann, Cailland, Minutoli, Drovetti, Ricci, Rohlfs, all of whom have written accounts of their journeys there, and of the antiquities of the place; several other travellers have sojourned there for short periods, and thus the Oasis is well known. The ancient Egyptians, as far back as the time of Seti I. (*circ.* B.C. 1350), called this Oasis "Sekhet-Ami," *i.e.* the "Field of the *Am* trees." And though such a name might well be given to any of the Oases, we are quite certain that Sîwah was thus called, for a text at Denderah describes Sekhet-Ami as "a name given to the mountainous countries of Qauuti which lie to the west of the border of the land of "Aḥ." Now Aḥ is the Oasis of Farâfra, which lies to the south of the Oasis Minor of the Romans (see Brugsch, "Reise nachden Grossen Oase," Plates xxiii. and xxiv., Leipzig, 1878).

It is probable that a small temple dedicated to some ram-headed god existed here in early times, but up to the present we have no definite evidence of the fact. In the time of Alexander the Great the god worshipped at the Oasis of Sîwah was identified with Amen-Rā, whose title was *Sept ābu* or "two-horned," and the Macedonian conqueror regarded him as his father. The Ptolemies did much for the Oasis of Sîwah, and it is more than probable that the temples and buildings there, which have been fully described by the old historian Diodorus, and by modern travellers, belong to the period of their rule over Egypt. The Arab writers knew nothing of the ancient history of Sîwah, as we may see from the meagre summary given by Yakût in his Geography (ed. Wüstenfeld, tom. iv. p. 873), and the information which they supply is generally distorted and legendary.

But to return to Mr. White's book. Of the twenty-six chapters of his narrative the greater number are devoted to detailing the incidents of his daily journey, and conversations with members of his caravan, and personal feelings and impressions about men and things. One chapter, based upon the works of French writers, is devoted to the Senussi, or followers of a certain "mad mullah" called Sidi Muhammad ibn Ali es-Senussî, who flourished in the first half of this century; three to the antiquities of Sîwah; one to a description of Jarabub, and so on. In the chapter headed "Ma'lèsh" he tells us that Egyptologists have assured him that he "has opened up the Oasis to them and to others," but how has he done it? We have examined his book carefully, but can find few antiquarian facts which were not known before; indeed, if he had drawn upon some work like Parthey's "Das Orakel und die Oase des Ammon," his book would have been more valuable and more interesting. He gives a description of a tomb in the "hill of the mummies" (*i.e.* Gebel Mûtâh, or "hill of the dead"), but without the hieroglyphic texts. This tomb Mr. Daressy first dated at B.C. 1200, but afterwards he wisely brought its date down to the time of Alexander the Great.

In Mr. White's description of the tomb we find *Amsel* instead of Amset, and *Duau-mulef* for Duau (*or* Tuau) -mutef, and *Kebh-sennef* for Kebh-sennuf; Prof. Sayce, who supplied the description, must be held guiltless of such mistakes as these. Mr. White's Arabic also is not above suspicion. Thus he writes *Ruffir* for Rafiyyeh, "shawl for the head" (p. 31); *Quies* for Kuwayyes, "good, pretty" (pp. 47, 69); in the Arabic name of God (p. 119), the *teshddîd* is over the wrong *lam*; *ma'es es-salâmeh* means "with peace," *i.e.* "good bye" (p. 196); *Ruttab* for *Rutub* (p. 232); &c. In short, Mr. White's book afforded him, no doubt, great pleasure in writing, but it seems that his want of knowledge of what other travellers have written about Sîwah has made him exaggerate the importance of his journey to archæologists.

Archæologists want copies of all the inscriptions which they can get from the Oases, and all the information possible; but the present state of Mr. White's archæological knowledge hardly entitles him to claim to have opened Sîwah to the Egyptologist. If he will first make his studies, and then visit the Oracle of Ammon, we shall be glad to hear what he has to say. His present work is written in a rather flippant style, and a sentence like the following jars upon us:—

"Abd-el-Gade did not reply." But his answer lay in his "embarrassed silence. Damn!" (p. 176). Mr. White's footnote to this is "An execration (*lapsus calami*)."

AN ITALIAN TEXT-BOOK OF PHYSIOLOGICAL CHEMISTRY.

Chimica Fisiologica per uso dei Medici e degli Studenti. By Dr. Filippo Bottazzi, libero docente di Fisiologia in Firenze. Vol. I. "Chimica Fisiologica generale." Pp. xv + 428. Vol. II. "Chimica Fisiologica speciale." Pp. xii + 465. (Milan, 1898.)

THIS work is initially interesting as being the first substantial text-book of the subject published by an Italian for Italian students. But it is much more than this. It is extremely well written, and differing as it does in many respects in both form and substance from the works with which we are already familiar, it is very suggestive as to many points of view from which the subject may in the near future make its most profitable advance.

A text-book of physiological chemistry must really be neither a treatise on physiology nor on chemistry. If it deals with the subject under the heads of respiration, nutrition, &c., it is too strictly physiological. On the other hand, if it consists chiefly of a list of substances and a description of their properties and methods of preparation and estimation, it is too chemical. Hence the author has divided the work into two parts. Of these, Vol. i. deals with general physiological chemistry, and studies the materials introduced into the living organism, the changes they undergo in the alimentary canal as they become assimilable, the mechanisms concerned in their absorption and assimilation, and finally the products of their disintegration in the living tissues as sources of energy. This complete metabolic cycle is treated in separate chapters (2–5), devoted to each group of the simple food-stuffs taken in the following order: "Inorganic substances" (water, salts, and certain gases), "Carbohydrates," "Fats," and "Proteids." These are preceded by a chapter on "The Elements," and followed by two dealing respectively with "Colloids" and "Ferments and Enzymes." This arrangement might at first

appear to be purely chemical, but in fact it is not; for although the chemical nature of the several substances and the more exact methods employed for their qualitative and quantitative determination are carefully recorded, the whole is looked at always from the purely physiological point of view of animal metabolism.

Dr. Bottazzi deserves special praise for having clearly realised the importance of the application of the more elementary ideas of physical chemistry to physiological and biological problems. He has hence given us here and there throughout this work concise but very clearly written statements of those conceptions of physical chemistry which are essential to the study of the properties of living matter, and which have so far never appeared in any existing text-book of either physiology or physiological chemistry. Thus in chapter ii. (pp. 37–64) he has dealt with the ideas which have led to the establishment of the modern theory of solutions, such as osmotic pressure, vapour tension, freezing-point, electrical conductivity, internal friction and viscosity. In chapter vi. (pp. 392–405) he gives the phenomena and laws of diffusion, dialysis, osmosis, and imbibition. This chapter is, moreover, of peculiar interest as dealing specially with the colloids as a group, and in a way not found in other text-books. This is most valuable when we remember that the animal organism is chiefly composed of colloidal substances, that they possess peculiar physical and chemical properties, due to the nature of their molecular aggregation, independently of those due to their constituent elements, and that these properties, continually making themselves felt, must play an important part in determining the mode of recurrence of vital processes.

The second volume opens with a long chapter (pp. 1–108) on "The chemistry of the living cell," as a suitable connecting link between the general physiological chemistry dealt with in the first volume and the special treatment in the second. In this the author has endeavoured, and with great success, to bring together all the scattered knowledge bearing upon the subject of the cell as the living unit, or, as he says, on the general problems of biological chemistry. This chapter is most instructive, and well worth reading from every point of view. Here again we find excellently clear explanations and applications of the phenomena of surface-tension, diffusion, osmosis in its strictest sense, and diosmosis; of plasmolysis and isotonicity. The succeeding chapters deal consecutively with the special subjects of blood, lymph chyle and serous fluids, the fluids of the organism in general, connective tissue, muscle, nerve, sense-organs, internal secretions, and so forth. The last three chapters treat of the digestive secretions, the liver, kidneys and urine.

In both volumes the several chapters conclude with a copious, well selected and representative bibliography of the subject-matter, carefully quoted in chronological order.

This book is full of good things, clearly stated and discussed suggestively. It would be easy to make a selection of them; but the list would be long, and we refrain from giving it in the hopes that thereby curiosity may be whetted and a desire aroused to read the original. S. L.

OUR BOOK SHELF.

Flashlights on Nature. By Grant Allen. With 150 illustrations by Frederick Enock. Pp. viii + 312. (London: George Newnes, Ltd., 1899.)

THIS is a bright and amusing account of a number of natural structures and problems. The economy of aphides, shrikes, earwigs, wasps, gnats, spiders and Hessian flies, of the Alpine Soldanella, clover, gorse, and water-weeds in winter is described in lively words and illustrated by figures, which are often both attractive and novel. The drawings of the earwig and Hessian fly are well worth the attention of professed naturalists; those of the gnat contain some small errors. Mr. Grant Allen has banished nearly every one of the technical terms which impede unlearned readers. In this he has done well, though we think that a technical name here and there in a footnote might have guided some few readers to fuller information.

Authors of elementary books do not feel bound to give chapter and verse for all their statements. But Mr. Grant Allen has gone too far in leaving out. He has rewritten Kerner's account of the Soldanella, the frog-bit and the curled pondweed, and adapted Kerner's figures of all three, without one word of acknowledgment.

L. C. M.

Spherical Trigonometry (Theoretical and Practical). Pp. viii + 116. By W. W. Lane. (London: Macmillan and Co., 1898.)

THE author of this book, who is one of the naval instructors on H.M.S. *Britannia*, has brought together the most important rules which are used in the solution of spherical triangles, and, after demonstrating the theory of each, introduces worked-out exercises for illustrating their actual use. The arrangement of the text seems to be well done, the student being led first to understand the geometrical relations between circles of a sphere, their spherical triangles, and after that the geometrical relations between the sides and angles of spherical triangles. Chapter iv. introduces for the first time the trigonometrical ratios, and this is followed by chapters in which the solutions of various types of triangles are dealt with. Throughout these the author makes the solution of the various problems very clear to the student by means of the figures which accompany the text, but the reader is nowhere directly advised to always construct figures for himself.

Although the author demonstrates and illustrates the use of the L haversine and tabular versed sine tables (tables which, by the way, are not used at examinations by the Civil Service Commissioners), he assumes that the reader knows the meanings of these terms. Perhaps it would have been more complete if these terms had been again defined. Thus we find that up to the end of the sixth chapter the beginner has been working with sines, cosines, tangents and their reciprocals; but in the next chapter, in the solution of a certain triangle, he is immediately confronted with

$$\text{hav } A = \frac{\text{vers } A}{2} = \frac{1 - \cos A}{2}, \text{ &c.},$$

without any previous hint as to what hav A or vers A means, although a more advanced student could find this out for himself. This, however, is a somewhat minor point, for the author provides other rules independent of these terms. Those, however, for whom this book is intended—namely, students preparing for examinations at the Royal Military Academy, Lieutenant R.N., B.A. London, &c.—will find the present treatise an excellent guide to the solution of spherical triangles, and the large number of well-chosen examples which are appended should prove useful.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Duke of Argyll and Mr. Herbert Spencer.

HAD I read Mr. Spencer's reply to the Duke of Argyll in 1888, I should have been even more astonished than the writer of the "Counter Criticism," that the Duke should have sanctioned the publication of his essays in their present form without a word of warning to his readers, that Mr. Spencer had not only not sanctioned but had explicitly denied the interpretation which the Duke had forced upon his analysis of the term "survival of the fittest." Any person would conclude from the first essay that Mr. Spencer had altogether abandoned this term, and (by implication) the factor of organic evolution expressed by it. I am sure that biologists will be generally glad to have it again authoritatively from Mr. Spencer himself that he is still so far Darwinian. He will also bear with me, I hope, when I point out that the mass of literature which the working man of science has to digest at the present time is so great that very few have time to seek light in the pages of the current magazines. Certainly we do not turn to these publications as a rule for information on scientific questions, and, I am bound to add, that the principles which determine the selection of writers on scientific subjects for such magazines have always appeared to me to be a profound mystery. It is not mere flattery when I state that we are in the habit of regarding Mr. Spencer's magazine contributions in the light of "preliminary notices," and that we always look forward to having them in a collected form at some later period.

With respect to the apparent change of attitude on the question of the relative importance of direct and indirect equilibration, I can, of course, only accept Mr. Spencer's explanation that the great prominence into which he has of late years brought the first of these factors, has led biologists in this country to suppose that he attaches more weight to it than he did formerly. It may be also that since the admissibility of this factor has been seriously questioned by those who accept the views of Prichard, Galton and Weismann, the attitude of each party has become unconsciously stiffened towards the other. In the passages from his "Principles of Biology," referred to by Mr. Spencer in his letter (which passages I had by no means forgotten), it is made perfectly clear that even at the time of writing that work he went beyond Darwin in the part assigned to direct equilibration. In his "Factors of Organic Evolution," published in 1886 in the *Nineteenth Century*, and collectively in 1887, Mr. Spencer certainly produces the impression that he is inclined to go still further in this direction:—

"Was the share in organic evolution which Mr. Darwin latterly assigned to the transmission of modifications caused by use and disuse, its due share? Consideration of the groups of evidences given above will, I think, lead us to believe that its share has been much larger than he supposed even in his later days" (p. 33).

"But the fact we have to note is that while Mr. Darwin thus took account of special effects due to special amounts and combinations of agencies in the environment, he did not take account of the far more important effects due to the general and constant operation of these agencies" (p. 46).

"But gradually with that increase of activity which we see on ascending to successively higher grades of animals, and especially with that increased complexity of life which we also see, there came more and more into play as a factor, the inheritance of those modifications of structure caused by modifications of function. Eventually, among creatures of high organisation, this factor became an important one; and I think there is reason to conclude that, in the case of the highest of creatures, civilised men, among whom the kinds of variation which affect survival are too multitudinous to permit easy selection of any one, and among whom survival of the fittest is greatly interfered with, it has become the chief factor: such aid as survival of the fittest gives, being usually limited to the preservation of those in whom the totality of the faculties has been most favourably moulded by functional changes" (p. 74).

I have not the least desire to raise once again the whole question as to whether "direct equilibration" plays any part at all in the development of species, but such passages as those above quoted, and generally the whole tendency to exalt this factor in the essays from which they are quoted, has produced a very widespread notion that Mr. Spencer has diverged more widely from Darwin now than he did in 1864. Personally I can only express satisfaction that Mr. Spencer has himself disillusionised us.

January 13. R. MELDOLA.

The late Prof. George James Allman, as a Botanist.

IN the notice of my distinguished namesake and friend—the late George James Allman—which appeared in NATURE of December 29, 1898, it is stated:

"Allman's first paper was a botanical one, 'On the Mathematical Relations of Forms of Cells of Plants,' and it is worthy of note that in this he in a sense anticipated one of the most recent among our biological departures."

This is not so. I send you herewith a copy of an "Abstract of a Memoir on the Mathematical Connection between the Parts of Vegetables," by William Allman, M.D., who was Professor of Botany in the University of Dublin, 1809–1844, and the predecessor of the late George James Allman in the chair. The memoir is plainly the paper referred to above, and was read before the Royal Society in the year 1811. GEORGE J. ALLMAN.

St. Mary's, Galway, January 2.

THE paragraph in my obituary notice of the late George James Allman, cited by Prof. George Johnston Allman, was intended to refer to a paper read before the British Association in 1835, entitled "On the Mathematical Relations of the Forms of the Cells of Plants," which heads the list of works ascribed in the Royal Society's Catalogue of Scientific Papers to George James Allman, and not to that by William Allman mentioned in the accompanying letter by his son, of which at the time of writing I was ignorant. While collecting data for my necrology of George James Allman, my suspicions were aroused by the fact that in the original form the paper alluded to by me is attributed but to a "Dr. Allman"; assuming, however, that the Royal Society's Cataloguer must have had authority for definitely associating it with George James Allman, I did not inquire further. In consideration of the point now raised, the matter becomes further complicated by the fact that the President of the Linnean Society, in making the award of the Society's Gold Medal to the late George James Allman in 1896, was, at my instigation, led to refer (*Proc. Linn. Soc.*, 1895–1896, p. 30) to the same paper in terms apposite to those of my obituary notice now under discussion. The memoir by William Allman, referred to by Prof. George Johnston Allman, is preserved in the Department of Botany, British Museum, together with a copy of an abstract of the same printed privately in 1844, as has been pointed out by my colleague at the Linnean Society, Mr. B. Daydon Jackson, in his article "William Allman" in the Dictionary of National Biography, on Prof. Allman's own authority, and by Prof. Percival Wright in his "Notes from the Botanical School in Trinity College, Dublin" (No. 1, p. 3); (*cf.* also Messrs. Britten and Boulger's "Index of British and Irish Botanists," p. 3). And on inspection, I find them accompanied by a letter to Robert Brown, dated 1844, which seems to show that the abstract was printed at his suggestion, *apropos* of an application by W. Allman for an appointment for which testimonials were being sought. MS. and abstract, and the paper to which I alluded, however, though cognate, are unquestionably distinct; and, on making further inquiry since the receipt of Prof. Allman's letter, I have been interested to find in the British Association's Index for the years 1831–1860 yet another of a similar character, recorded (but in title only) under the name of George James Allman. Mr. Griffith, the Secretary of the British Association, has very generously aided me by looking up the original records in his possession, and other reports and publications likely to bear on the question; and he informs me that he has no doubt whatever that the series of papers under discussion were by William Allman, pointing out that the paper regarding which I was misled by the Royal Society's Catalogue and British Association's Report is rightly attributed to him, on authority, in Poggendorff's "Handwörterbuch." Further consideration of the dates of events in the lives of the two Allmans fully bears this conclusion out. The series of papers were clearly expressive of successive phases in a long-cherished idea revolving in its author's mind for a period of nearly forty

years; and the whole source of confusion lies in the failure of those responsible for the British Association Reports of the time to insert the author's initials—the Allmans having been apparently referred to indifferently as merely "Professor" and "Dr."

While thus my precise statement concerning George James Allman's claim to distinction which is involved must be dissociated from his memory, perusal of his published writings still justifies us in regarding him as a scientific botanist of renown.

It has been pointed out to me that my reference to the late Beete-Jukes might be interpreted to mean that he was a professor in Trinity College, Dublin; and, in event of this possibility, I would remark that no such idea was intended. George James Allman was appointed professor of botany in Dublin University, in succession to William Allman, in 1844; resigning the appointment in 1856. Joseph Beete-Jukes became director of the Irish branch of the Geological Survey in 1850; and during the whole period of George Allman's occupancy of the Dublin botanical chair, the late Samuel Haughton was professor of geology. The allusion to the late Beete-Jukes was introduced into my notes by the kindness of a relative of the late George James Allman, and it is inaccurate as concerning the word "Professor," as I now find to be also the case with the word "Regius" as applied to the Dublin chair itself (which I owe to the obituary notice in the *Times* of November 28, 1898). "Professor" (line 19) and "Regius" (line 18) must accordingly be deleted from my article by those who would make further use of it; and I would remark that by "Grumera" (column 4), Gunnera is meant.

My best thanks are due to Mr. Britten, Mr. Griffith, and Prof. Percival Wright, for friendly assistance and advice in this interesting little bibliographic research, the limitations of which I appear to have by no means exhausted. G. B. HOWES.

Royal College of Science, London, S.W., January 9.

Since the above was written, we have received the following from Prof. Allman.—ED.

When writing the above I did not recollect that my father—many years later—read at the meeting of the British Association in Dublin (1835) a paper "On the Mathematical Relations of the Forms of the Cells of Plants" (Brit. Assoc. Rep. 1835, part ii. p. 79). This paper is erroneously attributed to Dr. George James Allman in the Catalogue of Scientific Papers of the Royal Society of London.—G. J. A.

January 16.

The Density of the Matter composing the Kathode Rays.

THE question of the size, charges and velocities of the carriers in the kathode rays has been made the subject of investigation by Prof. J. J. Thomson, Lenard, and others. I do not know whether it has been noticed that, by taking the values which have been obtained for the ratio of charge to mass, and for the velocity of the particles, in connection with the observed fact that a shaft of rays from a plane kathode retains its cylindrical form unaltered as it passes across the tube, we can arrive at a limiting value for the mass per unit volume of the matter composing the rays.

Take for simplicity a uniform circular shaft of charged particles travelling with velocity u. Let the mass per unit volume be m, the charge per unit volume e, the radius of the section a, and the velocity of light v. The shaft constitutes a current of strength $eu \cdot \pi a^2$. The magnetic force at the boundary is

$$H = \frac{4\pi \cdot eu\pi a^2}{2\pi a} = 2\pi aeu.$$

If we take unit volume at the boundary, it will be subject to an electro-magnetic force, inwards,

$$= H \cdot eu = 2\pi ae^2u^2.$$

The same unit volume will be acted upon further by an electrostatic repulsion outwards of amount $2\pi ae^2v^2$ in electromagnetic units.

Hence the resultant force on it will be

$$2\pi ae^2(v^2 - u^2) \text{ outwards.}$$

Now if ρ be the radius of curvature of the outer boundary, we have

$$\frac{mu^2}{\rho} = 2\pi ae^2(v^2 - u^2),$$

or the curvature is

$$\frac{1}{\rho} = 2\pi a\left(\frac{e}{m}\right)^2 m\left(\frac{v^2}{u^2} - 1\right)$$

We know that this curvature is small.

Taking the numbers given by Lenard (*Wied. Ann.*, 65, p. 504), we may put, roughly,

$$\frac{e}{m} = 6 \times 10^6$$

$$\frac{v}{u} = 4$$

giving

$$\frac{1}{\rho} = 2\pi a \cdot 36 \cdot 15 \cdot 10^{12} \cdot m$$

$$= ma \times 3{\cdot}4 \times 10^{13}.$$

Therefore m must be smaller than order 10^{-15}, whereas the average density in the tube, that of air at the pressure of a fraction of a millimetre, is of the order 10^{-7}.

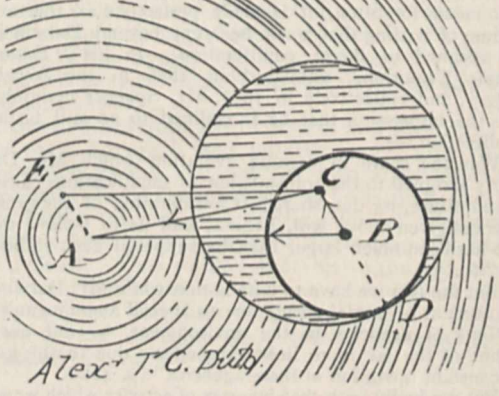
If we do not suppose that m and e are constant, but take them as functions of the distance from the axis of the shaft, we arrive at the above limit for the average density.

Queen's College, Belfast, January 9. W. B. MORTON.

Attraction in a Spherical Hollow.

AMONG the papers of the late Prof. Peter Alexander, of Anderson's Medical College, Glasgow, I find the enunciation of an interesting theorem in attraction. "The attraction on a particle of unit mass, in a spherical hollow in a sphere of uniform density, is at all points of the hollow parallel to the line joining the centres of the sphere and hollow, and is of constant magnitude equal to $\frac{4}{3}\pi c\sigma\kappa$. Where c is the distance between the centres, σ the density of the sphere and κ the attraction of unit mass on unit mass at unit distance."

I venture to give the following informal proof. Let A be the centre of sphere which may be supposed to be indefinitely great, and B a particle at the centre of the spherical hollow. Then the attraction on B is towards A, and is proportional to BA if the hollow be indefinitely small (see Dr. Tarleton's "Introduction to the Theory of Attraction," p. 13). But the removal of the spherical mass round B as centre in no way alters the attraction on the particle B. This proves the theorem for the central point. If the centre of the sphere were at C the attraction on B would then be BC in the same way. Let the



particle be now placed at C any point in the hollow. Produce CB to meet the hollow sphere at D. If the spherical hollow be enlarged so that C is its centre and CD its radius, the force of attraction on C will now be CA. Restoring the mass to the space between the new and the original hollows, subjects the particle at C to an additional force, equal and opposite to BC. Hence the force exercised on the particle at C in the original hollow is CE, which is parallel and equal to BA.

This furnishes a good example of the theorems (*ibid.*, pp. 60 and 94), that if one or other the amount or direction of the attraction within unoccupied space be constant, then must both be so.

There is probably a formal rigid proof of his theorem among my brother's papers. He told me that some practical application might be made, by having the hollow just touching the

surface of the solid sphere, at which point there might be a hole or door through which a small suspended magnet could be introduced into the interesting field of force.

THOS. ALEXANDER.

Engineering School, Trinity College, Dublin, January 2.

Fourier's Series.

PERMIT me to make a few remarks on the notes of Prof. Willard Gibbs and Mr. Love in NATURE of December 29, 1898.

Using Prof. Willard Gibbs's notation, write fx_n for the series

$$\sin x - \tfrac{1}{2}\sin 2x + \tfrac{1}{3}\sin 3x - \ldots \pm \frac{1}{n}\sin nx,$$

and let C_n denote the curve whose equation is $y = 2fx_n$.

Consider the two curves C_n and C_{n+1}. Then it is easily seen that these curves intersect, when $x =$ any multiple of $\pi/n + 1$; and (omitting proof, so as not to cumber your pages with calculation, which is not difficult) it will be found that one of the curves passes through the extremities of the maximum ordinates of the other, and the other through those of the minimum ordinates of the first, in each case the curves cutting one another at an angle whose tangent is 2. Hence if d is the distance along the ordinate of one of these points of intersection from the slant part of the limiting broken line ($y = x$), on one of the curves the like distance will be less than d on one side of the point, and greater than d on the other side. The statement of Prof. W. Gibbs that, "if any small distance be first specified, a number n' may be then specified such that for every value of n greater than n' the distance of *any* point in C_n from the broken line, and of any point in the broken line from C_n, will be *less* than the specified distance d," is therefore incorrect. It is doubtless true that C_{n+1} is, as a whole, nearer to the broken line than C_n, but it is not true that every point in it is so.

The above, in fact, shows, for a particular case, what Mr. Love has remarked in more general terms in his note.

I cannot follow Mr. Love in his remark—if, as I suppose from his argument, it is intended to be general and not limited to the particular illustration—when he says "Thus, in the passage to the limit, every point near the vertical part of the broken line disappears from the graph, except the points on the axis of x."

May we not as legitimately reason thus? The maximum ordinate of C_n nearest to $x = \pi$ is that for which $x = n\pi/n + 1$. There is a point P corresponding to a value of x between $n\pi/n + 1$ and π, whose ordinate is any fixed fraction (the half, say) of the above maximum. If now n be increased without limit, P will in the limit coincide with the point $\left(\pi, \frac{\pi}{2}\right)$. Thus the vertical part of the broken line, in this way of arriving at the limit, *will* appear in the graph.

Would it not be more correct to say that, when n is infinite, the limiting curve has ordinates for the value $x = \pi$ indeterminate within the limits $-\pi$ and π?

R. B. HAYWARD.

Shanklin, Isle of Wight, January 5.

The Decrease of Swallows and Martins.

WHAT an age of contradictions this is! a statement is put forth one day by some one who has apparently every reason to be an authority, and it is contradicted the next day by some one else who also appears to have good ground to support his contradiction.

Whom are we to believe?

Before preparing the paper on the decrease of the Hirundinidæ, which I was privileged to read at the conference of the Society for the Protection of Birds, I sought for, and obtained a large amount of valuable information on the subject, and embodied the chief details in my paper.

The most useful contribution concerning the destruction of small birds, including swallows, in Italy, was from the pen of Mr. W. J. Stillman, who was, until recently, the *Times* correspondent in Rome, and who, in the course of a letter published in the *Times* of August 23, 1898, wrote:—"Swallows are *netted* by the thousand as they come to the shores of Italy in their northward migration, and are *eaten as food*. They are also caught in quantities in the most cruel manner with artificial flies and fish-hooks." [The italics are mine.]

Another correspondent wrote to me personally, telling of the wholesale slaughter of birds in the neighbourhood of Florence, and in other parts of Italy, and although he does not, in his letter, actually specify swallows and martins as amongst the slain, yet it is not unreasonable to conclude they were amongst the many small birds which he has seen daily in Florence, piled up four or five deep on flat barrows, some five feet by three, and he also says he had been told that the *netters* are the real cause of the extraordinary absence of birds throughout Italy.

For many years past great complaints have been made against the French and Italians because of the great destruction of wild bird-life in the two countries; many people have protested against it, including "Ouida," who is, I believe, a resident in Italy, and who has on several occasions used her pen in defence of the birds.

My statements about the destruction of swallows in France were based on reports issued by the Agricultural, and the Zoological Society of France, the report of the latter body being subscribed to by three observers who had made special inquiries on the subject, and who wrote:—

"In the springs of 1887 and 1888, hampers were addressed to the naturalists of Paris containing dead swallows in the flesh, not only by hundreds, but by thousands. One lot of these birds, destined for the millinery trade, was spoilt owing to the impossibility of preserving them from putrefaction. These swallows had been captured in the Department of the Bouches-du-Rhône by means of three procedures—the net, by fish-hooks, and by electric wire."

In the report issued by the Agricultural Society of France, in 1894, it was stated on the authority of M. Rosier (delegate of the Society of Agriculture of the Gironde), "that in his district, at the season of their passage, there are killed every year more than a million of the Hirondelles."

The foregoing extracts will, I venture to think, prove that I did not speak without my book when I partly ascribed the decrease of the Hirundinidæ in this country to the massacre of such numbers of the family in France and Italy; and as a further proof that they do not come to our shores so abundantly as formerly, I have received letters from the keepers of some of our lighthouses, who report that during recent years they have remarked a very great falling off in the numbers of these birds at the time of the spring migration, and have wondered as to the cause.

In our own country the main disturbing element is, without a shadow of a doubt, to be found in the action of the house-sparrow, who has constituted itself a most persistent enemy of the swallows, especially the house-martin, whom it harries in every direction, and has been in many instances the cause of whole colonies of martins forsaking their old haunts.

I cannot altogether agree with the theory that the absence of the swallows in their old numbers is due to climatic changes, or to the decrease of their insect food; last summer this part of the country was swarming with winged insect life, so much so that some days the air seemed almost alive, and our rose and fruit trees were smothered with them, but in this town and its immediate neighbourhood swallows and martins were quite scarce, although all the local circumstances are, one would think, favourable for them in every way.

If climatic changes are an affecting influence against the coming of the swallows to this country, why are not other spring migrants affected in the same way? *i.e.*, the chiff-chaff (a much earlier immigrant than the swallow), the nightingale, the willow-wren, or the wagtails and many other species, which during the last few years have shown a tendency to increase. I do think, however, that the atmospheric conditions of some of our towns, especially where there are large factories and other sources of noxious vapours, may be the means of keeping the swallows away locally.

My belief then is, that a very large number of the Hirundinidæ are prevented from coming to us by the slaughter which awaits so many of them in the course of their journey from their winter quarters; and that when those who do survive the perils of the way ultimately reach this land, they are interfered with to such an extent by the sparrows that they are not able to multiply so freely as they would do under more favourable conditions, and so their number is kept reduced from year to year.

I am still seeking for trustworthy information from personal observers, and shall be most grateful for any communication that may be sent to me at this address, especially as I propose extending my paper and publishing it in the form of a pamphlet, in which will be included extracts from the letters which have come to me from all over the country.

J. HERBERT ALLCHIN.

Esher, Bower Mount Road, Maidstone, January 7.

FOSSIL VERTEBRATES IN THE AMERICAN MUSEUM OF NATURAL HISTORY.

IN May 1891, the American Museum of Natural History began to form its historical collection of the Fossil Vertebrates of North America. The new department of Vertebrate Palæontology was established for this purpose, and the Curator organised a series of expeditions to different formations in the Rocky Mountain region, beginning with the older tertiaries, and mainly under the direction in the field of Dr. J. L. Wortman, the well-known collector and investigator. Between 1891 and 1897 twenty distinct expeditions have been sent out, in several instances the same regions being revisited two or three times, with the object of securing complete material of certain types. In 1894 and 1895, and upon a larger scale in 1897, the explorations were extended into the Mesozoic rocks for fossil reptiles. But the main strength of the work hitherto has been among the fossil mammals, and the Eocene and Oligocene collections are now especially complete, embracing the remains of 3000 individuals determined stratigraphically with accuracy, and establishing several new sub-horizons of great importance. In 1895 the famous series of mammalian fossils brought together by the late Prof. Cope was added to these collections, embracing types of 555 species and upwards of 6000 individual specimens.

There are many sides of this work of interest to the vertebrate palæontologist, but we may describe here only the effort which has been made to secure for the Museum complete skeletons of the most typical forms in different geological periods. To every one familiar with the rarity of the older Tertiary types, the difficulty of this undertaking will be at once apparent. It is very seldom indeed that a complete skeleton like that of *Phenacodus* is found together in the older rocks. In ninety-nine cases out of a hundred, the skeletons are largely or wholly dissociated. Another difficulty is, that in the rare cases of association the skeletons are apt to be severely crushed beyond the possibility of reconstruction. In such cases only a drawing can be made. Despite all this the Museum has succeeded by persistent attacks upon one horizon after another, and by superior methods of field work, in securing a very representative series of complete skeletons partly belonging to single individuals, in some types to three or four different individuals, and in other types, as in the skeleton of *Teleoceras*, to a very large number of individuals. With the arrival in the Museum of this material in the crude condition from the field have arisen the mechanical problems of mounting these skeletons in various ways. This has received prolonged study, and after numerous experiments and some failures has now reached a high degree of perfection.

FIG. 1.—*Aceratherium tridactylum*, hornless rhinoceros from the Upper Oligocene of South Dakota. High relief mounting of a single laterally crushed skeleton.

It was at first believed impossible to mount a stone or fossilised skeleton free like a recent skeleton, and the first experiments upon a large Creodont or primitive Carnivore, *Patriofelis*, the bones were placed in high relief upon a background of matrix resembling the original rock in which the specimen was found. This method was also adopted in the skeleton of *Aceratherium tridactylum* (Fig. 1), which happened to be very much crushed laterally, and was therefore peculiarly fitted for mounting in relief. The result, as shown in the photograph, was highly successful. This skeleton, which is entirely original except the left fore limb, conveys to the visitor the idea of having been literally hewn out of the rock, and thus the two-fold impression of age and of fossilisation is at once given.

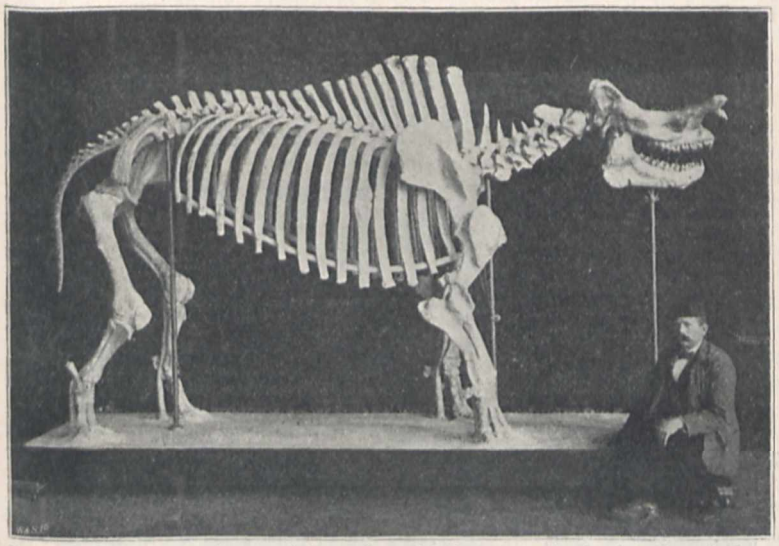


FIG. 2.—*Titanotherium robustum*, skeleton of one of the largest species, female. From the Lower Oligocene of South Dakota.

These reliefs, however, have the disadvantage of practically burying one side of the animal, and thus rendering many parts both immovable and difficult of access for purposes of study. In other words, the exhibition purpose too far supersedes the purely scientific and research purpose. An entire departure was therefore made in the skeletons of the swimming rhinoceros, *Metamynodon*, and of the great Titanotherium, both from the Oligocene.

A word will be of interest in regard to the discovery of these animals. The first remains of the Metamynodon were secured in 1892, namely, the skull and jaws and the greater part of the skeleton. A vigorous search in 1894 supplemented these parts by a complete left hind foot and an almost complete right fore foot. Bones of this animal are extremely rare, and the only pelvis which could be found belonged to an individual of slightly smaller size. With these materials, however, a complete skeleton was made up, and it shows clearly the many wide contrasts between this animal and the true rhinoceros. The animal in life was over nine feet long, and about five feet high, with habits rather like those of the hippopotamus than rhinoceros. In the same year, 1892, the fortunate discovery was made of a magnificent Titanotherium skeleton in South Dakota. The skull was first found in a somewhat fragmentary condition, and then the neck, entire trunk and fore limb, perfect even to the sesamoids, were excavated as far back as the last lumbar vertebra and the border of one ilium. At this point there was a great disappointment—the party encountered a sudden change in the rock, and found that the sacrum, the remainder of the hip and hind limbs had been carried away by an erosion which had probably occurred at some time after the original deposition of the entire animal. It required the work of two parties during the season of 1894 to secure the bones of the hind quarters of proper proportion belonging to the same species. The mounting method adopted, as fairly shown in the photograph (Fig. 2) consists in carrying steel rods upon the inner sides of the limbs and arches, to connect with a main rod

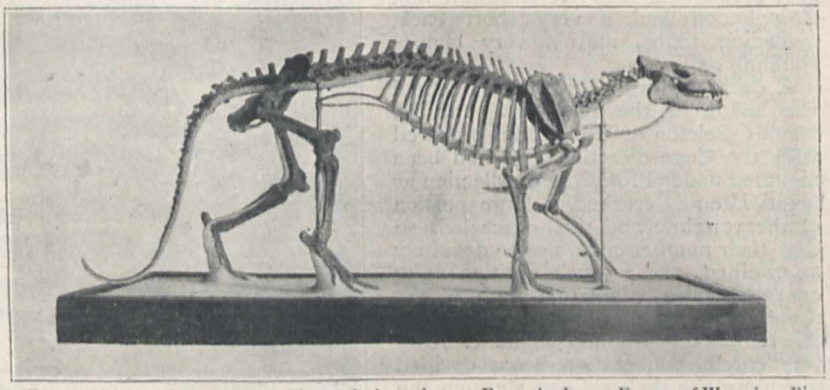


FIG. 4.—*Phenacodus primaevus*, the typical specimen. From the Lower Eocene of Wyoming, Big Horn Mountains.

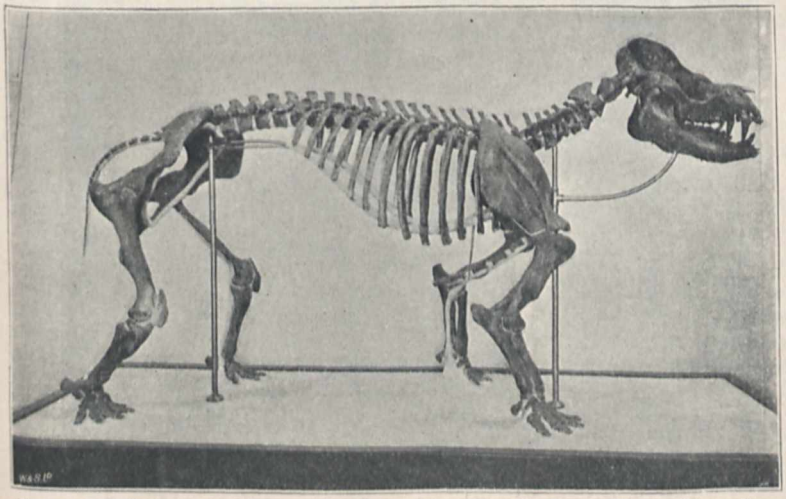


FIG. 3.—*Coryphodon testis*, skeleton of a large male. From the Lower Eocene of Wyoming, Big Horn Mountains.

which passes through the neural canal, this in turn being supported by two heavy uprights. The weight of this skeleton is enormous, yet it can be moved about without the least danger. It is perfectly rigid, and every part can be freely reached for purposes of study. As completed it stands about 14 feet long, 8 feet high, and 4 feet broad.

Another skeleton, mounted by a substantially similar method, belongs to the very rare animal *Coryphodon* (Fig. 3). This was also laboriously brought together after three separate expeditions to New Mexico and Wyoming, the complete remains being finally found upon a level in the Bad Lands adjoining the Big Horn River in northern Wyoming. It represents a number of different individuals, but there is no question that the remains belong to one species, and are of a fully adult type. In general one is struck with the very large size of the head, upon which can be seen swellings prophetic of the posterior horns of Uintatherium, the formidable tusks, heavy girdles, powerful fore limb bent out at the elbow, and a semi-plantigrade or subdigitigrade step. Other peculiar features are the shortness of the spines and the shortness of the ribs. It is shown that Coryphodon had a very short back, spreading limbs, and a very clumsy shuffling gait.

A decided advance upon this method was made in the remounting of the famous skeleton of Phenacodus procured with the Cope direction. It had been mounted under Prof. Cope's collection as found, laterally crushed, a large portion of the vertebræ and ribs concealed, so that their number could not be definitely ascertained, and in such position as to convey a false impression both of the proportions and mode of locomotion of this remarkably primitive ungulate. After very careful deliberation, it was decided to remove the skeleton entirely from the matrix, and remount it as nearly as possible in the natural position. This removal cost many months of labour, and two months more were occupied by Mr. Hermann, preparator, in setting up the animal as represented in the photograph (Fig. 4). In the course of the removal of the stone and plaster matrix the two missing cervical vertebræ were found inserted in the tail, and the number of ribs was definitely ascertained to be fifteen on each side, thus positively determining the dorsal vertebral formula—a matter of very great importance. These results alone justified the labour and expense involved, and the mount is now a model of its kind, since it not only displays the real anatomical character and natural position of the animal, but every bone on one side of the body or the other can be removed for purposes of detailed study. It strikes us as a rather slenderly built, straight-limbed animal, digitigrade like the tapir, five-toed, but almost exclusively supported upon three toes. Sir William Flower's restoration, in his volume upon the Horse, is very nearly correct; the upwardly arched back, powerful lumbar vertebræ, long hind quarters and long powerful tail, when contrasted with the much shorter fore quarters, rather low withers and small head, are all reminiscent of the clawed ancestry of this hoofed animal.

Of much more recent age is the skeleton of *Teleoceras*

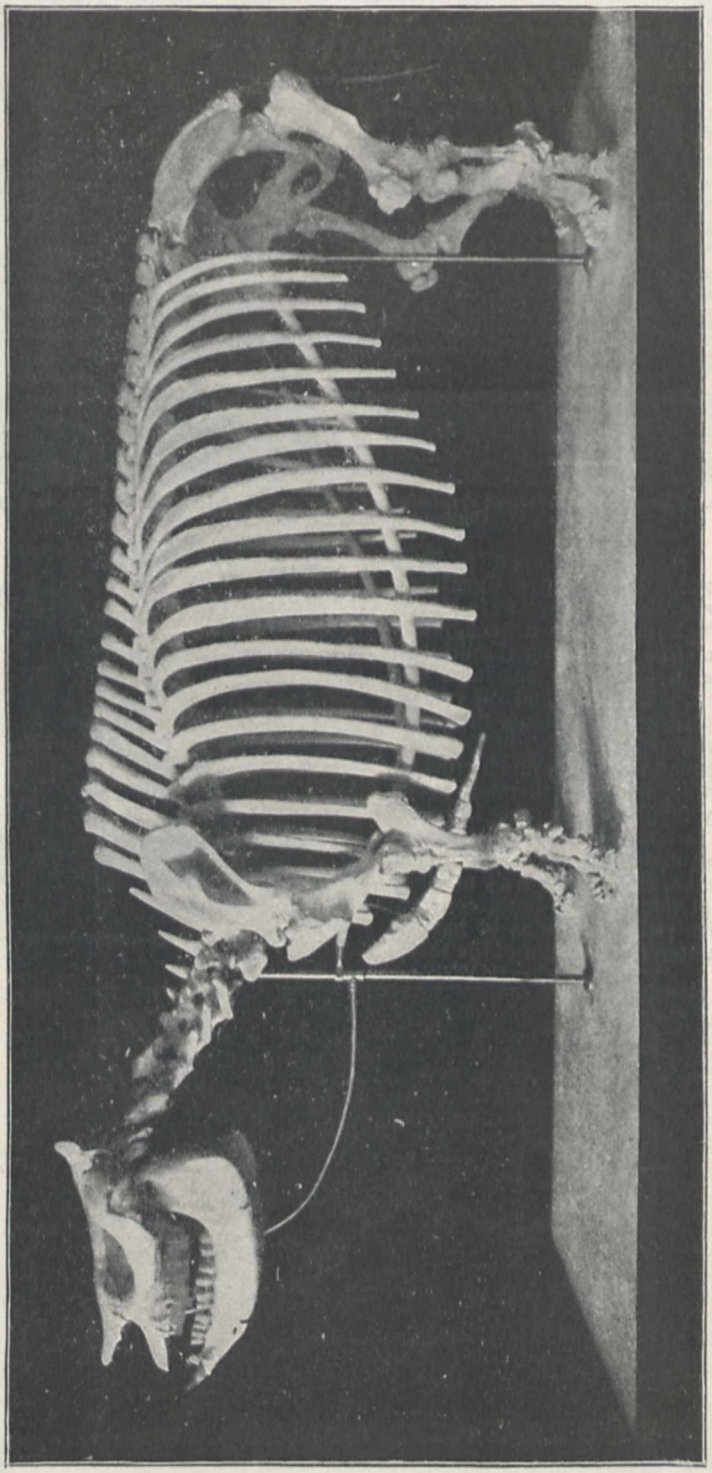


FIG 5.—*Teleoceras fossiger*, female rhinoceros with a small terminal nasal horn. From the Upper Miocene of Norther Kansas.

fossiger, a feebly horned rhinoceros living in great numbers at the top of the Miocene. This animal represents an aged female, of very large size, mounted from materials belonging to probably twenty individuals,

which were secured in Northern Kansas in the autumn of 1894 (Fig. 5). It comes from the famous quarry which has supplied several museums with more or less complete collections. From various accounts, and especially from our own observations, it appears that this quarry represents an old bone bed, probably the deposit of some stream or small river, along which the rhinoceroses herded in great numbers. Our party secured here over 400 complete bones, representing mingled remains of both sexes and of all sizes. Only in certain spots was the proximity of one specimen to another found to be a proof of association. By careful study of such occasional associations and selection of bones representing only the largest and oldest individuals, a skeleton was gradually brought together, which is believed to represent very nearly the correct proportions of this exceptional type. The dimensions are: length, 10 feet 2 inches; height at withers, 4 feet 1 inch; and greatest girth, 9 feet 2 inches. It thus appears that from head to tail *Teleoceras fossiger* was only six inches shorter than *Rhinoceros unicornis*, while the back is 18 inches nearer the ground. This remarkable lowering of the trunk is chiefly caused by the great reduction of the fore-arm, fore-leg, and metapodials. The abdominal girth exceeds that of the Indian rhinoceros, justifying Cope's assertion that this animal had rather the proportions of the hippopotamus than of the existing rhinoceros. Osborn and Scott undertook a restoration of the skeleton of this animal in 1890, but did not venture to give the ribs their full length, as they far exceeded those of any existing form. The length of rib as here shown is, however, beyond question. By comparison of this mount with those preceding, it will be seen that it presents a very marked advance in the method of mechanical construction. The only visible supports are the vertical uprights and the horizontal pieces holding the ribs. All the remaining supports are of steel, and consist of rods which traverse the centre of the various bones, even of the delicately arched ribs, and are thus entirely concealed. This method, which appears to be the most perfect of its kind, would be, however, impracticable in skeletons coming from the older Eocene rocks, which are composed of very much denser material.

Altogether there are now thirteen mounted skeletons exhibited in the Museum, and fifteen others are in various stages of preparation.

HENRY F. OSBORN.

NOTES.

WE have been asked by Prof. Meldola, the Hon. Organising Secretary to the Sylvester Memorial, to state that this Fund has now been closed, the subscriptions amounting altogether to over 890*l*. The capital sum has been invested by Lord Rothschild, the Treasurer of the Fund, on behalf of the subscribers, and the dividends will be transmitted to the Treasurer of the Royal Society. The engraving of the dies has been entrusted to Mr. John Pinches, and it has been decided that the material of the medal shall be bronze, that the award shall be triennial and irrespective of nationality, and that the recipient of the medal shall receive the accumulated (triennial) interest of the Fund, after deducting the cost of striking the medal. An autotype print of the medal will be presented to the subscribers by Prof. J. M. Peirce (of Harvard University) as soon as the dies have been engraved.

THE Geological Society of London will this year award its medals and funds as follows:—The Wollaston Medal to Prof. Charles Lapworth; the Murchison Medal to Mr. B. N. Peach, and a second Murchison Medal to Mr. John Horne; the Lyell Medal to Lieut.-General C. A. McMahon; the Bigsby Medal to Prof. T. W. Edgeworth David; the Wollaston Fund to Prof. J. B. Harrison; the Murchison Fund to Mr. James Bennie; the Lyell Fund is divided between Mr. Frederick Chapman and Mr. John Ward.

THE Institution of Electrical Engineers has made the following awards for papers read during the session 1897-98:—The Institution Premium to Mr. Horace F. Parshall, for his paper on earth returns for electric tramways. The Paris Electrical Exhibition Premium to Mr. Robert Hammond for his paper on the cost of generation and distribution of electrical energy. The Fahie Premium was not awarded because no telegraphic or telephonic papers had been read during the session. Extra Premium to Mr. Leonard Andrews, for his paper on the prevention of interruptions to electricity supply. Premium for original communications, to Mr. H. N. Allen, for his paper on sparkless reversal in dynamos. Students Premiums were awarded to Mr. J. M. Donaldson for his paper on the Dover electric tramways; Mr. Maurice Solomon, for his paper on Hertz waves and wireless telegraphy; and Mr. E. E. Tasker, for his paper on alternate current motors. Salomons Scholarships were awarded to Mr. Tom Rolls Renfree, King's College, London, and Mr. H. J. Tomlinson, University College, London.

A SHORT account of the recent celebration of the centenary of the St. Petersburg Military Medical Academy is given in the current number of the *Lancet*. The celebration commenced on December 30, 1898, when the congratulatory addresses of the presidents were presented. On Sunday, January 1, a visit was paid to the large non-military hospital associated with the Imperial Academy and to the Physical Laboratory, over which the delegates were shown by Dr. Danilevsky, who exhibited many experiments with liquid air, and demonstrated an apparatus by Zeiss by means of which images of small opaque bodies could be perfectly reproduced upon the lecturer's blackboard or screen. The chief part of Monday, January 2, was spent in a tour of inspection through the immense establishment on the islands at which all the instruments, splints, dressings, and apparatus are made for the army. On Wednesday, January 4, a miniature review was held by the Czar in an enormous riding school, and on its conclusion the delegates had the honour of being presented one by one to his Imperial Majesty. The British representatives were Rev. H. S. Cronin, Mr. Cross, Dr. Ferguson, Prof. Ogston, Mr. Owen, and Prof. Shipley. Throughout the entire series of functions the Minister of War showed by his presence that he deemed the Army Medical Department of real importance to his country. He expressed considerable pleasure at receiving congratulatory remarks from his visitors. It evidently gave him particular satisfaction to read out at the banquet before 500 guests a congratulatory telegram which arrived from the German Emperor.

THE *Lancet* states that on the occasion of the recent jubilee of the St. Petersburg Academy of Medicine, the following British men of science have been appointed honorary members of the Academy:—Sir William MacCormac, Bart.; Sir William Turner, Lord Rayleigh, Sir William Stokes, Dr. William MacEwen, and Drs. Thompson and Lauder Brunton.

PROF. CHANTEMESSE, of the Pasteur Institute, Paris, has been promoted to the grade of Officer of the Legion of Honour.

PROF. ALEXANDER G. R. FOULERTON has been appointed bacteriologist to the Middlesex Hospital.

PROF. POINCARÉ has been nominated president of the French Bureau des longitudes, M. Faye, vice-president, and Prof. Lippmann, secretary.

MR. J. G. BAKER, F.R.S., has retired from the post of curator of the Herbarium at Kew, in which he is succeeded by Mr. W. Botting Hemsley, F.R.S.

PROF. G. H. DARWIN, F.R.S., has been nominated president of the Royal Astronomical Society, for election at the annual meeting on February 10. Mr. F. W. Dyson has been nominated to succeed Prof. Turner as secretary.

WITH a view to encourage inoculation among its servants, the Madras Government has authorised the grant of three days' casual leave on full pay to those inoculated. The operation is purely voluntary. Similar concessions are granted to those attending the Government and aided schools.

IT is reported that an extraordinary long-distance telephone test has been made at Little Rock, Arkansas, by President Chas. J. Glidden, of the South-Western Telegraph and Telephone Company, who held a conversation over the wire with a Boston friend. The distance from Little Rock to Boston is 1900 miles.

THE Automobile Club de France announces a competition for motor-car accumulators, to take place in Paris in April next. Tests will be made on the life of the cells, and on their useful efficiency; and account will be taken of the "frequency, importance, and facility of operations for maintenance," and of the weight of the cells.

WE learn from *Science* that Prof. G. W. Farlow, of Harvard University, has been elected president of the American Society of Naturalists; Prof. R. S. Woodward, of Columbia University, has been elected president of the American Mathematical Society, in succession to Prof. Simon Newcomb; and Prof. John Dewey, of the University of Chicago, has been elected president of the American Psychological Association.

REUTER reports that the eruption of Vesuvius on January 15 attained great proportions, the flow of lava being greater than any which has hitherto occurred. Streams of lava are flowing down the mountain side, one passing near the observatory and another going in the direction of the lower station of the funicular railway.

THE death is announced of Dr. Constantine Vousakis, professor of physiology in the University of Athens.

THE death is announced of Brigade-Surgeon Lieut.-Colonel Robert Pringle, late of the Indian army. Lieut.-Colonel Pringle was for many years attached to the sanitary department of the North-West Provinces and Oudh, and took a keen interest in all problems connected with public health, especially in relation to India. He was the author of numerous papers and pamphlets contributed to medical journals, the Society of Arts, sanitary conferences, and other places.

THE death of Prof. Wilhelm Dames, professor of geology and palæontology at the University of Berlin, in his fifty-sixth year, is announced in the *Athenaeum*. He was a pupil of Beyrich, and succeeded him in 1896 as director of the geological-palæontological collection. Amongst his many scientific publications, his studies upon fossil fishes stand in the foreground. Since 1883 he had been the co-editor with E. Kayser of the Berlin *Paläontologische Abhandlungen*.

DR. GOTTLIEB GLUGE, Emeritus professor of physiology and anatomy in the University of Brussels, has (says the *Lancet*) died at Nice, aged eighty-six years, having been born in Westphalia in 1812. While a student in Berlin he worked with Froriep, who was prosector at the Charité, and discovered the oil globules in cells undergoing fatty degeneration. After a period of study in Paris he published an important paper on influenza treated historically and pathologically, for which he was awarded a prize by the Berlin Medical Faculty. In 1838 he was appointed professor of physiology in Brussels. His "Atlas of Pathological Anatomy" appeared in parts from 1843 to 1850. For the last twenty-three years he had been living in retirement.

The *Times* correspondent at Washington states that Prof. Worcester, of Michigan University, has been asked to be a member of the commission which President McKinley will send to the Philippines. It is understood that the commission will study the manners and habits of the Filipinos, the material resources of the country, and its commercial possibilities, but will not attempt to deal with the problem of its government. Dr. Schurman, president of Cornell University, will be president of the commission, which is expected to sail about February 1.

AN abstract of a report on the mineral resources of the Philippine Islands, sent by Dr. George F. Becker to the U.S. Geological Survey, is published in *Science*. Dr. Becker says that, so far as is definitely known, the coal of the Philippine Islands is all of the Tertiary age, and might better be characterised as a highly carbonised lignite. Lignite is widely distributed in the archipelago; some of the seams are of excellent width, and the quality of certain of them is high for fuel in this class. Coal exists in various provinces of the Island of Luzon, and a number of concessions for mining have been granted. Many of the other islands contain coal, and in the great Island of Mindanao it is known to occur at eight different localities. In the Island of Cebu petroleum has been found associated with coal at Toledo, on the west coast, where a concession has been granted. It is also reported from Asturias, to the north of Toledo on the same coast, and from Alegria to the south. Natural gas is said to exist in the Cebu coal fields. On Panay, too, oil is reported at Janinay, in the province of Iloilo, and gas is reported from the same island. Petroleum highly charged with paraffin is also found on Leyte at a point about four miles from Villaba, a town on the west coast. Gold is found at a vast number of localities in the archipelago, from northern Luzon to central Mindanao. In most cases the gold is detrital, and is found either in existing water-courses, or in stream deposits now deserted by the current. Copper ores are reported from a great number of localities in the Philippines. A lead mine has been partially developed near the town of Cebu, and there is iron ore in abundance in Luzon, Caraballo, Cebu, Panay, and doubtless in other islands. Sulphur deposits abound about active and extinct volcanoes in the Philippines.

A REUTER correspondent at Cadiz reports that the coffin containing the remains of Christopher Columbus has been opened. It was found to contain about thirty bones and some ashes. The coffin was then closed again and conveyed on board the despatch boat *Giralda*, which was to leave on Wednesday for Seville, where the remains of Columbus will be received with great ceremony and deposited in the cathedral.

THE prize awards of the Paris Academy of Medicine are announced in the *British Medical Journal*. This year, as usual, the most noteworthy features were the decisions of the Academy as to the Audiffred, Laborie, Chevillon, and Adrien Buisson prizes. Two years ago Madame Audiffred gave a capital sum, estimated to produce an income of 2400 francs (96*l*.), to be awarded as a prize to any one who shall discover a means of curing or preventing tuberculosis. Among the serious workers who competed, special mention is made of Dr. Auclair, of Paris, who has made interesting researches on the substances extracted from the tubercle bacillus, and has shown that the fatty matters contained in excess in the bacillus are necrosing agents, and doubtless play a part in the resistance of the bacilli to phagocytosis. A sum of 80*l*. was awarded to him by way of encouragement, while 20*l*. was given on the same

ground to Drs. Auché and Hobbs of Bordeaux. The Laborie prize (200*l.*), for the best work in surgery, was divided between MM. Poncet and Bérard of Lyons. The Chevillon prize of 60*l.* is given for the best work on the treatment of cancerous diseases. This year a portion of it (40*l.*) was awarded to Drs. A. Guinard and Livet, who have used carbonate of calcium as a local application with considerable success as far as the relief of pain and the arrest of hæmorrhage and the prevention of fœter are concerned. The Buisson prize consists of a sum of 420*l.*, awarded triennially to the discoverer of methods of curing diseases regarded as incurable. This year there were only three competitors: Dr. Frenkel, who propounded a method of training whereby ataxic patients may be drilled into the recovery of muscular coordination; Dr. Jayle, who has made a series of investigations as to the practical utility of ovarian extract in the treatment of nervous and circulatory disorders accompanying dysmenorrhœa and the menopause, whether natural or artificial; and Dr. Petit, who presented a thesis on tuberculosis of the glands of the neck. The Academy did not see its way to award the prize, but gave 40*l.* each to Dr. Frenkel and Dr. Jayle, and 20*l.* to Dr. Petit by way of encouragement.

THE performances of the submarine vessel, *Gustave Zédé*, appear to have given much satisfaction to naval experts on the other side of the Channel, though our own engineering papers are by no means impressed by the experiments. We learn from the *Times* that the semi-official *Moniteur de la Flotte*, commenting upon the trials of the *Gustave Zédé*, says that at length, after twelve years of continued efforts, the problem has been solved. The *Gustave Zédé*, unassisted, has steamed from Toulon to the Salins d'Hyères and to Marseilles, sometimes on the surface and sometimes submerged, and has successfully discharged her missiles at the mark. On the surface she is almost invisible, and presents a target scarcely capable of being hit; below water her presence is revealed neither by the noise of her engine nor any movement of the surface. The objection raised against the submarine boat that she is blind loses force, since the *Gustave Zédé* makes momentary appearances on the surface to redirect her course, while she has a telescopic tube, with an arrangement of prisms and mirrors, utilising the principle of the *camera obscura*, which permits the surroundings to be surveyed, though imperfectly, in case of emergency. The *Gustave Zédé* has a restricted range, owing to the great weight of the electric accumulators; but the new boats of the Narval class will have auxiliary steam for surface navigation.

SOME interesting particulars with reference to the White Star liner *Oceanic*, which was successfully launched from the Belfast ship-yard of Messrs. Harland and Wolff at the end of last week, and is the longest and heaviest ship yet projected from a slip-way, are given in *Engineering* of January 13. The following table shows how the new vessel compares with others:—

Steamer's name.	Date.	Moulded dimensions.						Draught.		Displacement.
		Length.		Breadth		Depth.				
		ft.	in.	ft.	in.	ft.	in.	ft.	in.	
Great Eastern	1858	680	0	83	0	57	6	25	6	27,000
Britannic	1874	455	0	45	0	36	0	23	6	8,500
Arizona	1879	450	0	45	2	37	6	22	0	—
Servia	1881	515	0	52	0	40	6	23	3	9,900
Alaska	1881	500	0	50	0	39	8	22	0	—
City of Rome ...	1881	542	6	52	0	38	9	22	0	11,230
Oregon	1883	500	0	51	0	40	0	23	0	—
Paris	1888	527	6	63	0	41	10	23	0	13,000
Teutonic	1890	565	0	57	6	42	2	22	0	12,000
Campania ...	1893	600	0	65	0	41	6	23	0	—
Kaiser Wilhelm der Grosse ...	1897	625	0	66	0	43	0	—		20,000
Oceanic	1899	685	0	68	0	49	0	32	6	28,500

The displacement of 28,500 tons given in the table for the new vessel is that at the load draught, which, as stated, is 32 feet 6 inches. The passenger accommodation of the *Oceanic* will be for 410 first-class passengers, 300 second-class, and 1000 third-class passengers, whilst the officers, crew, and other members of the ship's company will be 394, bringing the total up to 2104 persons.

ON Thursday last (January 12) the whole of the British Islands experienced a storm of unusual violence, which caused much loss of life and damage to property both on land and at sea. The storm was noteworthy because of the suddenness of its appearance and the rapidity with which it travelled, as well as for the area which it covered; for while the centre of the disturbance passed over Scotland, its fury was felt far to the south of the English Channel. On the morning of the previous day the Weather Chart published by the Meteorological Office showed that, although small secondary depressions were crossing our islands from west to east, the symptoms were favourable for an improvement of the recent unsettled weather, and the observations taken at 6h. p.m. on Wednesday showed that the barometer was steady or rising all along the western coasts. The chart for 8h. a.m. of Thursday showed that the barometer had fallen more than half an inch at some stations during the night, and that the northern part of Ireland was already experiencing the full force of the gale that had suddenly set in from the Atlantic; at Belmullet, in the north-west of Ireland, force 12 of the Beaufort wind-scale, or a complete hurricane, was blowing. During the day it rapidly spread to other parts of the country, a heavy south-west gale was blowing in the Channel, with terrific seas, and very heavy gusts and rainfall were experienced in London. By the next morning (Friday) the centre of the disturbance was passing over Germany and the Baltic, the storm area having travelled at the unusually high rate of about thirty-four miles an hour.

AT the Institution of Civil Engineers, on January 10, a paper was read on "High-speed Engines," by Mr. J. H. Dales. In applying provisions for eliminating knock in double-acting engines, Mr. Dales has found that the ordinary rates of rotation can, with practical immunity from overheating, and an absolute freedom from seizure of bearings, be exceeded to the extent of 30 per cent. to 50 per cent. This has been effected by providing a close-up, and at the same time expansible, adjustment of bearing brasses, and so reducing the production of heat to only that caused by the rotation of a shaft as distinguished from the usual cause of seizure—namely, the expansive force of the metal of both journal and brasses.

ON August 15 and September 17, 1897, three earthquakes occurred in Turkestan, which, considering their comparatively slight intensity, were recorded by horizontal and other pendulums over a very wide area, the most distant station being more than 5000 km. from the epicentre. In each case the estimates of the velocity vary greatly, and Dr. Agamennone, who has studied the records, considers that the differences are to be ascribed to the variety of the instruments employed, rather than to any uncertainty in the time-records. It is important to notice that the highest velocities are always given by the Italian pendulums, which therefore appear, in spite of their mechanical system of registration, to be the most sensitive to these disturbances.

THE publication of Cohn's *Beiträge zur Biologie der Pflanzen* will not be discontinued owing to the death of Prof. Cohn. It will still be brought out, as heretofore, at irregular intervals, under the editorship of Prof. O. Brefeld, his successor in the chair of Botany at the University of Breslau.

THE *Botanical Gazette* announces two expeditions for the purpose of discovering food-plants and others of economical

value suitable for introduction into the United States—one by Mr. W. T. Swingle, to the Mediterranean coasts of Europe, Asia, and Africa; the other by Mr. D. G. Fairchild and Mr. B. Lathrop, to both coasts of South America.

THE addition to the British flora of a species belonging to so well-known and conspicuous an order as the Orchideæ, is an unexpected circumstance. Mr. H. Goss has been fortunate enough to accomplish this in the case of *Orchis cruenta*, Muhl., which he has found growing abundantly in several spots in boggy ground at an altitude of about 1000 feet, between Borrowdale and Watendlath, in Cumberland. *O. cruenta* is nearly related to *O. incarnata* and *O. latifolia*, being regarded by some authorities as a variety of the latter. The discovery is especially interesting as adding one more to the small number of specially Arctic plants comprised in our flora. It has hitherto been known only in Norway, Sweden, and Finland. It should be looked for in Scotland.

IN a paper published in the *Annals of Botany* for December, Mr. H. Wager appears to have set at rest the much-disputed question of the presence of a nucleus in yeast-cells. In all the species of *Saccharomyces* examined—*S. Cerevisiae*, *Ludwigii*, *pastorianus*, and *Mycoderma*—he finds what he calls a "nuclear apparatus," that is, a special portion which appears to be set apart to perform the function of a nucleus. This nuclear body is perfectly homogeneous, even when observed under the highest powers of the microscope, and appears to correspond rather with the nucleole of higher plants. One of these bodies is found in every yeast-cell. In addition to the nuclear body, there is in every yeast-cell a structure of the nature of a vacuole, which appears to be an essential part of the nuclear apparatus, and to possess some of the attributes of a nucleus. This structure has often been mistaken for the nucleus itself.

PROF. W. B. CLARK, State Geologist, reports, in the *Johns Hopkins University Circular* for November, on the progress of the Maryland Geological Survey and Maryland Weather Service during the session 1897-98. Established in 1896, the aim of the Survey has been to inaugurate those investigations which would prove most beneficial to the people of the State, and at the same time contribute most largely to the knowledge of the stratigraphy and structure of the country. With the aid of a surveying force provided by the United States Geological Survey, a large area has been surveyed topographically on the scale of an inch to a mile. The geological work is systematically divided, and a competent man placed in charge of each large district. Subjects such as the highways and road-metals, agriculture and soils, distribution of plant and animal life, and terrestrial magnetism are dealt with by officers specially chosen for the purpose. Prof. G. P. Merrill conducted investigations on the building and decorative stones. Statistical data are collected regarding the output of each industry that has to do with the mineral wealth of the State. The Survey, in short, is conducted in a way that reflects the highest credit on the State Geologist. As director of the State Weather Service, he carries on this branch of work in close co-operation with the State Geological Survey, the State Agricultural Institutions, and the United States Department of Agriculture. Reports from the State Weather Service are promised upon the physiography, meteorology, medical climatology, agricultural soils, forestry, hydrography, crop conditions, botany, and zoology of Maryland.

WE have received, from Messrs. J. Elster and H. Geitel, an excerpt paper from *Terrestrial Magnetism* for June last, on a method of determining the direction of vertical electrical currents in the atmosphere by observations of atmospheric electricity. In connection with this subject, we would draw attention to an important article by Mr. W. Trabert in *Meteorologische Zeitschrift* for November last, on the connection between the phenomena of terrestrial magnetism and the electrical processes in the atmosphere, in which special reference is made to the above paper. Messrs. Elster and Geitel have pointed out that the direction of any vertical current from the surface of the earth, induced by a process analogous to electrical dissipation or conduction, is completely determined by the sign of the electricity of the ground, or, what is the same thing, by the sign of the potential over the corresponding locality. Thus if the surface of the earth is everywhere negatively charged, there must be a downward vertical current due to conduction. But they also point out that cases are imaginable in which the conveyance of electricity occurs in the opposite direction, and must be traced to some other process, either mechanical or one which is at present quite unknown. It may possibly be due to the effects of terrestrial magnetism, and be detected by measurements of atmospheric electricity.

AN elaborate series of tests on cadmium standard cells has been undertaken by Mr. S. N. Taylor (*Physical Review*, vol. vii. pp. 149-170, 1898). The ratio of the E.M.F. of the Clark cell (15° C.) to the Cadmium cell (21·7°) is given as 1·4077; this may be compared with the Reichsanstalt determination, 1·4063, and with the recently published value, 1·40663, of Jaeger and Kahle, *Zeitschr. für. Instrk.*, June 1898. Assuming that the E.M.F. of the Clark cell is 1·433 volts, the Cadmium cell has an E.M.F. of 1·0180 volts. But the value of the Clark cell is not definitely established to the third decimal place; its E.M.F. is variously stated as follows:—Rayleigh, 1885, 1·4345; Carhart, 1·434; Glazebrook and Skinner, 1892, 1·4342; Kahle, 1896, 1·4322.

THE new issue of *Natural Science*, which has lately changed hands, differs little from the numbers with which we have for some years been familiar. The original communications include the Friday evening address delivered by Prof. W. J. Sollas before the British Association at Bristol, on "Funafuti: the Study of a Coral Atoll." Mr. T. J. Cunningham discusses in detail Prof. Weldon's evidence of the operation of natural selection, expressed in the presidential address before the section of biology at the same meeting of the Association. Mr. H. C. Wyld writes on biological analogy and speech development, and Dr. A. T. Masterman contributes an article upon the subject of symmetry of organisms. In addition to these articles, there are the usual critical notes and comments, reviews, a budget of fresh facts, and items of news.

THE *Transactions* of the Leicester Literary and Philosophical Society, New Series, vol. v. Parts 1 and 2 (July and October, 1898), contain the following papers on entomology: "A Group of Insects' Home-made Cradles," by G. B. Dixon; "Notes on the British Longicornes," by Horace Donisthorpe; "On the Genera Depressaria and Gelechia," by Rev. Canon Cruttwell; and "On the Evolution of the Hind Wing in Lepidoptera," by W. J. Kaye. The *Proceedings* of the Sections include numerous shorter notes on various branches of natural history, though entomology seems to receive the lion's share of the attention of the naturalists belonging to this energetic local society.

BOUND in a strong handsome cover, and containing excellent illustrations from beginning to end, volume ix. of the *Practical Photographer* (Percy Lund, Humphries, and Co., Ltd., London) consists of the issues for the past twelve months, and forms a volume which every amateur photographer would like to possess. Among the numerous articles will be found interesting criticisms of the pictures exhibited at the various photographic exhibitions held during the year, practical notes on the different branches of the art, descriptions of the styles of work, and illus-

trations of pictures taken by some of the more well-known photographers, and many other subjects too numerous to mention, but which are of practical use to the amateur. Great pains have apparently been taken to ensure the successful reproductions of the pictures included in the 370 pages which compose this volume, and a perusal of even these alone may give hints to many amateurs on the somewhat difficult tasks of lighting, pose, &c.

THE additions to the Zoological Society's Gardens during the past week include a Gazelle (*Gazella dorcas*, ♀) from Egypt, presented by Mr. J. S. N. Allison; a White-cheeked Hill Partridge (*Arboricola atrigularis*) from the Naga Hills, Assam, presented by Mr. K. S. Cassells; a Regent Bird (*Sericulus melinus*, ♂) from Australia, a Weka Rail (*Ocydromus australis*) from New Zealand, a Black-headed Lemur (*Lemur brunneus*), bred in the Gardens, deposited; two Gluttons (*Gulo luscus*, ♂ ♀) from Northern Europe, a Common Otter (*Lutra vulgaris*), British; three Australian Rails (*Rallus pectoralis*), two White-cheeked Honey-eaters (*Meliphaga sericea*) from Australia, a Red Ground Dove (*Geotrygon montana*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

COMET CHASE.—This comet, which is now about as bright as it was at the time of its discovery last year, has the following ephemeris for the current week :—

Berlin Midnight.

1899.	R.A. (app.).	Dec. (app.).
	h. m. s.	° ′
Jan. 21 ...	11 9 55 ...	+32 27·7
23 ...	9 55 ...	32 50·7
25 ...	9 48 ...	33 13·4
27 ...	9 35 ...	33 35·9
29 ...	11 9 16 ...	+33 57·9

VELOCITY IN THE LINE OF SIGHT OF η PEGASI.—In a previous number of the *Astrophysical Journal* (vol. viii. No. 3), Prof. Campbell pointed out that his observations had indicated that the motion in the line of sight of the star η Pegasi (R.A. 22h. 38·2m., Dec. + 29° 41′·2, mag. 3·1) is variable. Writing in the *Astronomische Nachrichten* (No. 3536), Herr Belopolsky tells us that he is able to corroborate this statement from observations made by him at the Pulkova Observatory. The following are the results of his measures of this star, the number in the last two columns representing the velocities per second in geographical miles, in relation to the earth and sun respectively.

	Motion relative to	
	Earth	Sun.
1897 Aug. 27 ...	−1·70 ...	−0·66
Sept. 8 ...	−1·03 ...	−0·64
1898 Aug. 25 ...	+1·27 ...	+2·29
Sept. 17 ...	+3·05 ...	+2·26

The mean of Belopolsky's values for the two years thus reduce to −4·8 and +16·9 kilometres per second, while those of Campbell for 1897 July-September and 1898 August-September, are given as −4·3 and +16·2 kilometres per second. These values it will be noticed agree well with one another, and indicate further the accuracy that can now be obtained in such measures.

THE LEONIDS IN 1898.—In the December number of the *Monthly Notices* there are several communications on the meteors seen in November last, to which we have not yet drawn our readers' attention. At the Cape Observatory, Dr. Gill had made special provision for obtaining both eye observations and photographs on the nights of the 13th and 14th.

For the latter work, five cameras were arranged to cover the region round the radiant point, while a Cooke doublet was directed towards the radiant. All the cameras were fixed to equatorials, and the plates changed every hour. No photographic results were obtained, and, indeed, the eye observations indicated that the shower was nothing out of the ordinary. No more fortunate was Dr. Copeland, who, with some assistants, watched on the nights of the 13th to 15th. At Cambridge, Mr. Hinks, who with several other observers kept their vigil during the same three evenings until dawn, and were perhaps a little more fortunate on the 14th, when from 11h. to 18h. thirty-two Leonids were seen.

The shower seems, however, to have been better seen in America, as will be gathered from the following extracts of a letter from Prof. Barnard to Dr. Johnstone Stoney. Prof. Barnard watched on the nights of the 11th-16th, between the hours 5 p.m.–6 a.m.

He writes :—"The sky cleared shortly after midnight on the 14th. I soon saw there were a few meteors, but not noticeable, which could be traced back to the radiant, though they were mostly low in the north-west, near α Cygni. They became more frequent, and some large ones were seen. From this till daylight several hundreds were seen—many of the first magnitude, and a few brighter. Very few were seen near the radiant, and none at it." As regards the time of greatest frequency of the meteors, Prof. Barnard says :—"It seemed to me the maximum was reached between 3 and 4 a.m., perhaps nearer 4. It was the finest display of meteors I have yet seen."

On the 16th and 17th, not a single Leonid was observed by Prof. Barnard. Five cameras were employed to record the trails, but the development of the least promising of them has given no trails.

NEW INSTRUMENT FOR MEASURING ASTROGRAPHIC PLATES.—Now that photography is so largely used for obtaining charts of the stars, several styles of measuring instruments have been devised to obtain directly the coordinates of the star discs from the negatives. The great difficulty in designing such instruments is that simplicity of construction, accuracy of measurement, and rapidity of working must be well combined. The most recent form is that which we owe to Dr. Gill, and which will be found fully described and illustrated in the *Monthly Notices of the R.A.S.* (vol. lix. No 2). While taking advantage of the rapidity of Prof. Turner's method, Dr. Gill has retained the accuracy which is attainable with the filar micrometer. The result, as Dr. Gill states, has fully realised his expectations, "thanks to the artistic skill and care of Messrs. Repsold, to whom I entrusted the carrying out of my plans." The whole process of measurement is "so simple that an observer without any previous knowledge or experience in practical work of the kind can, after very short training, easily measure the two coordinates of eighty stars per hour (including diameters); and were it not that the observers are instructed to work very carefully, a larger number could be measured in the same time."

THE SPECTRUM OF THE CORONA.[1]

THE announcement by Prof. Nasini of the possible presence of the characteristic green line of the corona in the spectrum of the gases collected at the Solfatara of Pozzuoli (NATURE, vol. lviii. p. 269, July 21, 1898) renders it desirable that I should at once publish some of the results of an investigation relating to the spectrum of the corona with which I have lately been occupied.

In the course of my early observations of the spectrum of the chromosphere, I discovered on June 6, 1869, a bright line at 1474 on Kirchhoff's scale, which I stated to be coincident with a line of iron (*Roy. Soc. Proc.*, vol. 18, p. 76).

During the total eclipse of the sun on August 7, 1869, a green line was recognised by Prof. Young as belonging to the spectrum of the corona, and the position of this line was also stated to be 1474K.

Although other determinations of the position of the green line of the corona during eclipses have not all agreed absolutely with Young's observations, the differences have been attributed to errors of observation, so that Young's statement of the coincidence of the coronal and chromospheric lines, and their correspondence with the solar dark line at 1474K has been generally accepted. No special attention appears to have been directed of late years to the measurement of the corona line itself.

This and other coronal radiations were photographed as rings by the use of prismatic cameras in 1893, 1896, and 1898, but a full list of them has only so far been published for the photo-

[1] Paper read before the Royal Society on November 24, by Sir Norman Lockyer, K.C.B., F.R.S.

graphs taken by Mr. Fowler during the eclipse of 1893 (*Phil. Trans.*, A, vol. 187, p. 593). Among the brightest of these rings, which is common to all three sets of photographs, is one about wave-length 4231, which probably is identical with the corona line photographed by Schuster in 1886, and stated to have a wave-length of 4232·8 on Angström's scale (4233·4 Rowland). Schuster stated that this line was "probably the same line as 4233·0 often observed by Young in the chromosphere" (*Phil. Trans.*, A, vol. 180, p. 341). The chromospheric line at this wave-length has since been identified as an enhanced line of iron, of which the precise wave-length is 4233·3. Captain Hills photographed this corona line with a slit spectroscope in the last eclipse, and he gives its wave-length as 4233·5 (*Roy. Soc. Proc.*, vol. 64, p. 54), which within the limits of error might be considered coincident with the enhanced line of iron.

The later researches on the spectrum of iron have shown that the iron line which I observed in 1869 to be coincident with the bright chromospheric line at 1474K (5316·79 Rowland) is also an enhanced line, agreeing absolutely with Young's latest determination of the wave-length of the 1474 chromospheric line (Scheiner's "Astronomical Spectroscopy," Frost's translation, p. 425), with which, according to his eclipse observations, the green line of the corona is coincident.

According to these results then, two of the chief lines in the spectrum of the corona would be coincident with enhanced lines of iron. The remaining corona lines which have so far been measured, are not, however, coincident with enhanced tines. It did not seem possible, therefore, that two of the enhanced lines of iron should be present without the others, even if it be admitted that the corona may have a tempe rature high enough to produce any enhanced lines.

It appeared then, either that the coincidences of the chromospheric and coronal lines about 423 and 531 were accidental, or that they were not real coincidences at all. A careful examination of the eclipse photographs of 1896, taken by Mr. Shackleton, and those of 1898, taken by Mr. Fowler, has therefore been undertaken, with special reference to this point.

The wave-length of the coronal ring at 4231, already published in case of the 1893 photographs, has been confirmed.

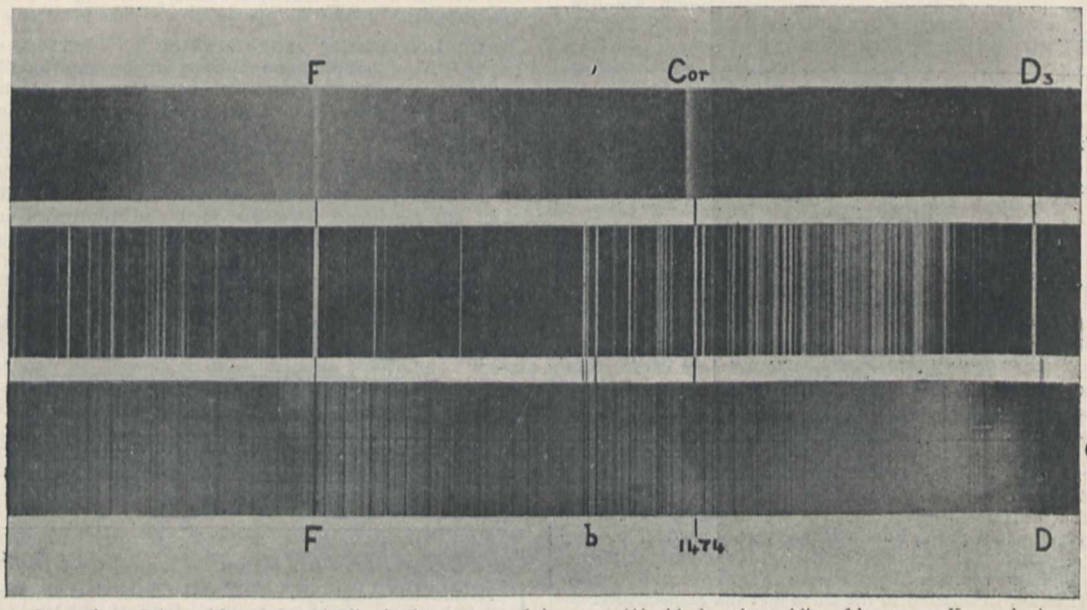
The 1896 and 1898 photographs further indicate that the corona line near 4231 is not coincident with the chromospheric line to which reference has been made, and show that while the chromospheric line is coincident with the enhanced line of iron at λ4233·3, the corona line has a wave-length of 4231·3.

With regard to the ring in the green, the lack of sufficient photographs on isochromatic plates in 1893 does not permit of a final determination of wave-length. Important data, however, were obtained, both in 1896 and 1898. A measurement of the position of the chief ring in the green, as shown in these photographs, comparing the ring with the spectrum of the chromosphere and a solar and iron spectrum taken by the same prisms, shows beyond all question that the wave-length is very different from that generally accepted. The mean result of measurements of different parts of the ring made by Messrs. Fowler and Shackleton and Dr. Lockyer is 5303·7, or about 13 tenth-metres more refrangible than 1474K (5316·79).

Although the new wave-length is not to be regarded as final, for the reason that the conditions under which the photographs were taken necessitate certain small corrections which have not yet been fully worked out, it is not likely that it can be in error by so much as 1 tenth-metre.

The examination of the photographs, which has been undertaken in the first instance by Mr. Fowler, indicates that other important conclusions are to be drawn from the admirable series obtained by him, among them the possible existence of one or more new gases, some of the lines of which, as gathered from the dispersions as yet available, appearing also in the spectra of some stars and planetary nebulæ.

The photograph which accompanies this paper has been prepared by Mr. Fowler.



Comparison of the position of the chief line in the spectrum of the corona (A) with the enhanced line of iron at 1474K, seen in the spectrum of the chromosphere (B) and in the ordinary solar spectrum C.

HIGH VACUA PRODUCED BY LIQUID HYDROGEN.[1]

AS an illustration of the extraordinary power of the new cooling agent—liquid hydrogen, the extreme rapidity with which high vacuo can be produced by its use is, perhaps, one of the most striking. The absolute boiling points of hydrogen, oxygen, and chlorine are respectively 35°, 90° and 240°, in other words oxygen boils at a temperature two and a half times higher than liquid hydrogen, and liquid chlorine similarly at two and a half times that of liquid oxygen. From this we infer that liquid hydrogen as a cooling agent ought to be relative to liquid air as effective as the latter is compared to that of liquid chlorine. Now chlorine at the temperature of boiling oxygen is a hard solid, some 80° below its melting point, and in this condition has an excessively feeble vapour pressure.

[1] "Application of Liquid Hydrogen to the Production of High Vacua, together with their Spectroscopic Examination." Paper read at the Royal Society on December 15, 1898, by James Dewar, F.R.S.

When liquid hydrogen freezes air out of a sealed tube by immersing the end in the liquid, it is to be inferred that no measurable pressure of air ought to be left in the vessel. If we apply Van der Waals's law of corresponding temperatures to the case of hydrogen, the above inference is made unimpeachable. An approach to some knowledge of what the tension of air must be about the boiling point of hydrogen can be attained by exterpolating the vapour pressure curves of oxygen and nitrogen. Taking the following range of boiling point temperatures for nitrogen and oxygen, viz. from the critical point to the boiling point under diminished pressure, two Willard Gibbs formulæ were calculated, with the following results :—

Nitrogen ...	Temp. abs.	127°	78·6°	59°
	Pressure in mm. ...	25,900	740	26

Nitrogen. $\log_{10} p = 11{\cdot}5561 - \frac{400{\cdot}02}{T} - 1{\cdot}8980 \log_{10} T$ ...(1).

Oxygen ...	Temp. abs.....	154°	90·3°	61·3°
	Pressure in mm...	37,592	740	7·5

Oxygen. ... $\log_{10} p = 9{\cdot}4699 - \frac{422{\cdot}22}{T} - 0{\cdot}9843 \log_{10} T$..(2).

Another Gibbs formula was calculated, taking Estreicher's values for the vapour pressure of liquid oxygen below its boiling point, viz. :—

Temp. abs.	91·44°	78·1°	62·8°
Pressure in mm.	743·8	141·8	7·5

Oxygen. $\log_{10} p = 16{\cdot}0670 - \frac{524{\cdot}72}{T} - 3{\cdot}8024 \log_{10} T$..(3).

We deduce from these formulæ the following vapour pressures at the temperature of boiling hydrogen :—

(1) Nitrogen	...	0·0015	Pressure in mm., 35° abs.
(2) Oxygen	...	0·000076	do.
(3) ,,	...	0·000016	do.

The results of calculation, taking the formulæ for the widest range of pressures, viz. (1) and (2), may probably be the surest, but in any case those values must be taken as a *maximum*, seeing they refer to the liquid state, while both oxygen and nitrogen, at the temperature of 35° absolute, are hard solids, and must therefore have dropped to lower tensions than that of the exterpolated liquid vapour pressure curves. It is curious to note that at this low temperature the theoretical ratio of the tensions of nitrogen and oxygen is as 20 to 1. Direct measurements of the vapour pressure of nitrogen at the melting point, or 60° absolute, gave the value of 26 mm., and a ratio of the tensions of nitrogen to oxygen of 6 to 1, whereas from the curves the value ought to be 6·7 to 1. Olszewski gives the tension of nitrogen at − 214° as 60 mm., and as at this temperature the oxygen tension is 3·8 mm., the ratio of the saturated pressures of the two gases at the melting point of nitrogen would be as 16 to 1, which is far too high. Probably the oxygen value will be nearest the truth, seeing it has the lowest melting point. The tension is about a ten millionth of an atmosphere. In the case of nitrogen, the maximum theoretical pressure would be one five hundred-thousandth of an atmosphere. It is safe to infer that the vacuum left after liquefying the air out of a vessel by means of liquid hydrogen cannot exceed the millionth part of the atmospheric pressure, exclusive of the pressure resulting from any incondensable material other than nitrogen and oxygen. This is just about the pressure of the vapour of mercury at the ordinary temperature in the Torricellian vacuum, so that as good an exhaustion ought to result as can be got by boiling out a space with mercury. There is another way in which the question may be put. Assuming the molecular latent heats are approximately proportioned to the absolute boiling points, then we can, from a comparison with the oxygen value, deduce that of hydrogen, and thereby get the constants in a two term formula for the vapour pressures. For pressures below an atmosphere, the following approximate formulæ were deduced :—

Oxygen ..... $\log p = 7{\cdot}2058 - \frac{392{\cdot}6}{T}$ mm. . . (4).

Hydrogen ... $\log p = 7{\cdot}2428 - \frac{152{\cdot}7}{T}$ mm. . . (5).

From these expressions it follows that at its boiling point, or 35° absolute, hydrogen has 7/852000 times the pressure of oxygen, or the latter pressure is about the eight millionth of an atmosphere. A similar formula, calculated from the critical and boiling point data, gives substantially the same order of quantities. Formulæ (4) for oxygen tensions must be fairly accurate, seeing it gives a theoretical latent heat of about 56 units per gram of liquid evaporating at the boiling point, whereas direct determinations result in 55 units. To test this inference, the following plan of experimenting was adopted :—Ordinary shaped vacuum tubes, like A, B, used for the spectroscopic examination of gases, with and without electrodes (Figs. 1 and 2), having a capacity ranging from 15 to 25 c.c., had pieces of quill tubing about a foot long sealed on. The tubes were contracted at D to about 1 mm., so that they could be sealed off with rapidity. The end C sometimes terminated in a small bulb (Fig. 3), in order to give increased cooling surface, and, when necessary, to allow many times the volume of air in A, B, to enter and be condensed with the object of accumulating any incondensable residuum.

The tubes were filled with air, oxygen, and nitrogen at the atmospheric pressure. The liquid hydrogen collected in the vacuum vessel, immersed in another similar vessel full of liquid air, being ready, the end C was dipped in the liquid for a little over a minute, and the tube AB sealed off at D, so that on removal from the hydrogen bath the solid air might melt and distil off without generating any pressure. On attempting to

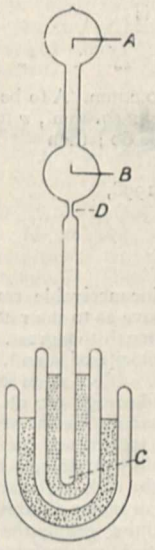


FIG. 1.

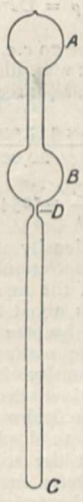


FIG. 2.

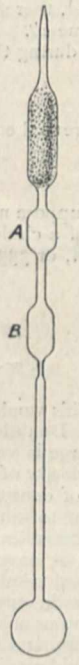


FIG. 3.

pass the spark through vacuum tubes prepared in this manner, their excellent exhaustion was revealed by great resistance to the passage of the discharge, and the high phosphorescence of the glass. Two tubes, kindly prepared by Sir William Crookes with platinum electrodes that he had previously sparked to remove gases and impurities on the glass before filling with dry air, gave, when treated in the manner described, such high vacua that the tubes had to be heated in order to get any spark to pass. Thus it is proved that the tension of solid nitrogen and oxygen at the temperature of boiling hydrogen is below the millionth of an atmosphere, seeing there is less difficulty in getting a discharge to pass in tubes exhausted to this extent. In order to get some definite idea of the limit of the exhaustion produced, two tubes, such as have been described as suitable for the liquid hydrogen experiments, might be joined together and filled with oxygen or nitrogen at atmospheric pressure, and simultaneously exhausted with the mercurial pump to a small fraction of an atmosphere, and then sealed off from the pump

and each other. One of these two identical tubes could then be subjected to the hydrogen cooling, following the directions already given, and the two vacuum tubes now compared. If there was a marked difference in resistance to the passage of the discharge in the frozen tube, then something must have condensed, and by a few tentative trials a limit might be reached when the initial exhaustion was unaffected by the hydrogen cooling. Such experiments have not yet been made. The presence of any vapour of mercury would require to be carefully eliminated, otherwise the method would not be satisfactory. Tubes that are prepared without taking special precautions to exclude organic matter and water from the glass, deteriorate, especially with electrodeless tubes after the discharge has taken place for some time.

The rapidity with which the vacua are attained is such as theory would suggest, assuming a hole of a square millimetre in section through which the air rushes into the condenser and that a velocity of current between 600 and 700 feet a second is attained, then a vessel of 20 c.c. capacity could be reduced in pressure in 1 second to 1/10 of the initial pressure, and if the same rate is continued at the end of 60 seconds to $(\frac{1}{10})^{60}$. Sir George Stokes has been good enough to consider the problem and writes as follows:—

"Let V be the volume of the vessel, A the area of an aperture by which the air is conceived as rushing out with the velocity v, ρ the density of the air in the vessel at the time t, D the initial density, that is, the atmospheric density.

"Then, according to our hypothesis, $Av.dt$ is the volume of air, and, therefore, $Av\rho.dt$, the mass of air, which rushes out in the time dt. But this equals the loss of mass of air in the vessel during the time dt, and, therefore,

$$Av\rho \,.\, dt = -Vd\rho,$$

a differential equation of which the integral is

$$\rho = De^{-Avt/V}.$$

"Suppose now V to be 20 c.c., or 20,000 c.mm., A to be the area of a circle of 1 or 2 mm. diameter, say 2 sq. mm., v to be 333 m., or 333,000 mm., t (in seconds) to be 60; then

$$\log_e \frac{D}{\rho} = \frac{2 \times 333{,}000 \times 60}{20{,}000} = 1998,$$

$$\frac{D}{\rho} = 5254 \times 10^{434}.$$

"This would give a density of almost inconceivable smallness. Doubtless the supposition made above as to the rate of discharge is very wide of the mark, being much too great. If the velocity of rushing is about half the velocity of sound, the ratio of densities would become 72×10^{217}. If so it is satisfactory to find that the mathematical following out of the hypothesis leads to a density of the residual air in the vessel which is enormously below what suffices to account for the observed result." A practical mode of rapidly attaining a high vacuum in any vessel is to displace the air with carbonic or sulphurous acid, either at the atmospheric or under diminished pressure, and then to freeze out the remaining gas by the use of liquid air, just as in the experiments with liquid hydrogen.

The first vacuum tube was an electrodeless one, the air had not been dried, nor the glass specially cleaned. On spectroscopic examination it showed hydrogen lines bright along with the second or compound line spectrum of the same gas, and a series of bright bands defined on the less refrangible side, diffuse on the more refrangible, which occur in the yellow, green, blue, and indigo. These bands were found to be identical with the carbonic oxide spectrum. With a Leyden jar in the secondary circuit the line spectrum of hydrogen disappeared, leaving the second spectrum fainter; but the carbonic oxide bands remained bright, and there was no appearance of the hydrocarbon spectrum. The second tube had aluminium electrodes, and, like the last, had no special treatment in filling in the air. This tube showed also the line spectrum and the second spectrum of hydrogen; the latter being bright along with the carbonic oxide spectrum; but on sparking the latter disappeared. No appearance of the hydrocarbon spectrum could be detected, but there was a suspicion of bands in the indigo like the negative pole spectrum of nitrogen. The addition of a Leyden jar brought out nothing new, only intensifying the line spectrum of hydrogen, while leaving the second spectrum bright. In neither of the above tubes could any lines of nitrogen or oxygen be recognised. The third tube was filled with air drawn over cotton wool, red-hot copper oxide, and phosphoric pentoxide, no rubber joints being employed. The spectrum showed the carbonic oxide bands and the hydrogen line spectrum as before. Only the second hydrogen spectrum was feeble. There was a yellow line W.L. 5849, identical with one occurring in the natural gas from the King's Well at Bath. In a paper on "The Liquefaction of Air and the Detection of Impurities" (*Chem. Soc. Proc.*, November 1897), the separation of helium from this gas is described by liquefaction and fractionation, and it was observed that during the sparking the helium lines were well marked along with "*others, the origin of which must be settled later.*" It was further observed, "*With a modified form of apparatus it will be possible to collect any residuary gas from the use not of 3 cubic feet of air or Bath gas, but from hundreds of cubic feet of such products.*" The helium and other associated material was shown to be more volatile than nitrogen. Pursuing this course of investigation in the summer of this year, the volatile portion of air was examined, when the presence of material giving the same lines as Bath helium was recognised. While this investigation was in progress, Prof Ramsay and Dr. Travers observed the same spectrum in the more volatile portion of argon which they have associated with a new element called neon. The use of liquid hydrogen, as described, proves that the most characteristic line of neon in the yellow, about W.L. 5849, can be detected in 25 c.c. of ordinary air, and the presence of helium in the atmosphere is confirmed.[1]

A fourth tube, filled like the preceding one, had a phosphoric pentoxide tube left on. This showed again the carbonic oxide bands, but no hydrogen lines could be detected; while the oxide of copper ought to have removed all free hydrogen and transformed all the organic matter into carbonic acid and water. Yet it appears that the spectrum of the carbon compounds is difficult to remove from electrodeless tubes, probably owing to carbonic acid coming from the glass. There were some broad diffuse bands that may arise from the drying agent. The absence of hydrogen in this tube suggests that its presence in the third tube was due to vapour of water coming slowly from the glass. I am greatly indebted to Prof. Liveing for making a careful examination of the spectra of these tubes.

Sir William Crookes was good enough to prepare two tubes with platinum electrodes, which he sparked in vacua till all hydrogen disappeared, and then filled with dry air, but without the use of red-hot copper oxide or any agent for the absorption of carbonic acid or the destruction of organic matter. After the cooling with liquid hydrogen, he found on spectroscopic examination, in one no hydrogen, but two faint lines, one about 5852 W.L. and the other 5676 W.L. The second tube showed the same yellow about 5852, the helium line along with 5939 and 6145, the hydrogen lines C and F, and some red lines. The observations of Crookes confirm the presence of neon, helium, and hydrogen. The absence in his tubes of the carbonic oxide spectrum is important, seeing all the electrodeless tubes gave this spectrum. In these tubes the vacuum was very high, and it was difficult to observe the gaseous spectrum. Still, the fact of finding hydrogen in one and not in the other, leaves the presence of free hydrogen in the atmosphere as a question for further inquiry. The tube that did not contain hydrogen was heated very hot in order to get a discharge, and then the spectrum showed some bands like the negative glow of nitrogen. Occasionally, a jar discharge was got to pass, and when this took place the nitrogen lines could be seen. An electrodeless tube filled carefully with oxygen made from fused chlorate of potash, which was contained in an extension of the vacuum tube, gave nothing but the carbonic oxide bands. In future experiments it will be easy to concentrate all the least volatile material in air or other gases, and thereby to make a more thorough examination of the spectrum. In the meantime my object is to show one of the scientific uses of liquid hydrogen.

I have to thank Mr. Robert Lennox for efficient aid in the conduct of the difficult experiments. Mr. Heath has also helped in the work.

[1] In a paper along with Prof. Liveing, "On the Spectrum of the Electric Discharge in Liquid Oxygen, Air, and Nitrogen" (*Phil. Mag.*, 1894), we noted that during the distillation and concentration *in vacuo* of liquid oxygen and air under diminished pressure, that two bright lines appeared in the spectrum at wave-length 557 and 555, and that one of these lines was very near the position of the auronal line. These lines are now attributed by the same chemists to a new element, crypton.

GEOLOGY OF SOUTH-WESTERN NOVA SCOTIA.

A REPORT, by Dr. L. W. Bailey, dealing with the geology of a portion of the Province of Nova Scotia, appears in the annual report of the Geological Survey of Canada (vol. ix., 1896), just issued. Until recently, but little was known of the geology of this region; indeed, the only important references thereto are those contained in the "Acadian Geology" of Sir Wm. Dawson, and these were almost wholly confined to the seaboard. The interior, being essentially unfit for settlement and difficult of access, received little or no attention until, in the year 1891, as a consequence of the interest aroused in gold mining, something like a systematic survey was begun. The results of this exploration, extending over several years and including four counties, with portions of a fifth, are contained in the volume just published.

Glacier-ploughed trough in Cambrian Rocks, Lockport Island, Nova Scotia.

Of the formations described, that occupying the largest area is granite, but this, instead of being represented, as in previous descriptions, as simply forming a belt of uniform width and constituting the axis of the peninsula, is shown to possess an exceedingly irregular contour, besides being disclosed either by extrusion or denudation in many detached areas. Enwrapping the granite, but along the lines of contact invaded by the latter in the most complicated way, are the rocks usually styled the "Nova Scotia gold series." These are also styled Cambrian, though it is stated that as yet no positive proof that such is their age has been obtained. The rocks appear to be essentially non-fossiliferous, and by some authors are regarded as being Pre-Cambrian. They consist of three principal members, of which the lowest and chief one is composed of heavy beds of quartzite alternating with slates, the second of argillites which are often parti-coloured, and third of black slates, usually highly charged with pyrites. Their thickness is very great, certainly 10,000 feet, and probably much more than this. Ridged up by pressure from the Atlantic side, but at the same time affected by strains more or less transverse to the trend of the coast, they present a series of dome-like folds, varying from nearly circular to elliptical or linear in outline, of which the centre is usually composed of quartzites and the encircling beds black or coloured slates. It is in connection with these domes or anticlines that the principal dislocations have been determined, and, on account of their intimate connection with the development of gold veins, have received much attention and are somewhat minutely described. Quite a number of mines exist within the area considered, and some of them are yielding large returns. In the neighbourhood of the granite the Cambrian rocks are greatly altered, but gold veins are comparatively few in connection with the more highly metamorphosed strata.

In addition to the supposed Cambrian rocks there are, in Digby and Annapolis counties, considerable areas occupied by more recent rocks, viz. Eo-Devonian and Triassic. These are confined to the neighbourhood of the Bay of Fundy, the former containing large numbers of fossils of about the age of the Oriskany sandstones of New York, and the latter wholly unfossiliferous, embracing red sandstones in the Annapolis Valley and traps in the North Mountains, which overlook the latter from the northern side.

The region presents many features of interest as regards its superficial geology, the most striking being the numerous fiord-like indentations of the coast, the great numbers and large size of the erratics with which the surface is strewed, the occurrence of kames, or horse-backs, in some instances thirty miles in length, and the evidences afforded on the coast of deep glacial ploughings. One striking instance of this is given in the accompanying photograph—but others, of much greater depth and breadth, have been observed.

The report is accompanied by a coloured map, on which, in addition to the separation of the various rock-formations, the more important "Domes" and gold districts are clearly indicated.

SCIENTIFIC WORK OF THE U.S. DEPARTMENT OF AGRICULTURE.[1]

WEATHER BUREAU.

ARRANGEMENTS have been made to establish stations for making meteorological observations and displaying hurricane signals at Kingston, Santiago de Cuba, Santo Domingo, St. Thomas, Barbados, Dominica, Trinidad, Curaçao, and Barranquilla.

When the West Indian service is fully established twice-daily reports will be received, not only from the stations named, but also from Habana, Nassau, Vera Cruz, Tampico, Coatzacoalcos, and Merida. The improved storm-warning service will largely benefit the commercial interests throughout the West Indies.

The Central Meteorological and Magnetic Observatory of Mexico has begun the equipment of about thirty stations in the Mexican Republic, with the most approved meteorological instruments, and will establish a meteorological service similar to our own. When completed, an exchange of reports, especially those relating to the approach of West Indian hurricanes and "northers" in the Gulf of Mexico, will be effected.

Aerial observations by means of kites were continued during the year. It was hoped to establish at least twenty stations, but it was found that only sixteen could be completely equipped. It is too early to express an opinion regarding the value of the observations already secured in the aerial work of the Bureau.

The importance of the study of meteorology in the United States has been kept in mind, especially in the assignment of observers to duty at points where there are colleges or universities not already provided with instructors in meteorology, and during the past year the courses in meteorology have been strengthened in a large number of high schools and academies.

The Bureau has begun the collection of statistics of loss to farm property, including live stock in the fields, by lightning, so as to determine the frequency of lightning stroke and the amount of property destroyed annually by that phenomenon.

VEGETABLE PHYSIOLOGY AND PATHOLOGY.

The work of this Division is carried on with a view of obtaining additional light on the conditions governing the growth and

[1] Extracted from the Report on the work of the U.S. Department of Agriculture for the year ending June 30, 1898.

production of cultivated plants, with special reference to diseases, nutrition, and development of new and improved sorts by breeding and selection.

During the year valuable knowledge was obtained relative to increasing the sugar and starch-producing power of plants, and the effect of soil foods on their growth and productiveness.

The work of hybridrising the sweet orange with the hardy trifoliate, with a view of obtaining a variety resistant to cold, was pushed on, and about one hundred and fifty hybrids obtained. In addition to this about one thousand hybrids of other citrus plants were obtained. Considerable work was done in crossing pineapples, and as a result two hundred and fifty-nine hybrid seedlings were secured. These produced plants of great vigour, and confirmed the belief that by this means there may be produced fruits which will be larger, of better quality, better shippers, and more resistant to blight. Similar work was carried on with pears and with wheat and other crops.

Biological Survey.

With a view to determining the areas best adapted for various crops, the Biological Survey has been engaged for several years in collecting data for mapping the natural life zones of the United States. A detailed study of the distribution of the native animals and plants has been made in the belief that areas inhabited by indigenous species coincide with those most suitable for certain varieties of fruit and cereals and for breeds of domesticated animals. This investigation has now progressed far enough to permit the publication during the past year of a revised map of the life zones of the United States and two reports containing the results of more general interest to farmers and horticulturists.

One of these reports comprised a description of the life zones and crop zones of the United States, with lists of the more important varieties of fruits and grains adapted to each area; the other, an investigation of the geographic distribution of some of the more important cereals.

The Biological Survey is often called upon to determine the value of birds and animals to practical agriculture. A careful study is made of the food of useful and injurious birds and mammals, and thousands of stomachs of birds are examined in the laboratory. Two thousand three hundred and twenty-nine stomachs, mainly of sparrows, swallows and woodpeckers, were examined during the year. A report has been published on the native cuckoos and shrikes (see p. 61), and reports on flycatchers and native sparrows are in preparation. Several of the latter birds feed largely on weed seed during the winter, and it is a matter of no little interest to determine how far they can aid the farmer in checking the increase of noxious weeds. The importance of this work is emphasised by the increasing demand made on the Department for information and publications on birds, in consequence of the recent widespread popular interest in ornithology.

Forestry.

At the end of the fiscal year the creation of the New York State College of Forestry and the election of Mr. B. E. Fernow to the directorship created a vacancy in the position of Chief of the Division, which Mr. Fernow held for twelve years, and Mr. Gifford Pinchot, of New York, was appointed his successor.

One of the most useful lines of work has been an investigation of the forest conditions of the State of Wisconsin, in co-operation with the State Geological Survey (see p. 82).

The accumulated data of the investigations in timber physics has been worked out in part and yielded some most important results, among which the law that the strength of a beam at the elastic limit is equal to the compression strength of the material, which was established by the tests of the Division, will influence the practice in the use of wood for construction most advantageously.

Agrostology.

Through the efforts of this Division the needs of the several sections of the United States are being determined, and the forage problems which they have to meet are being found. The work leads to a better knowledge of the distribution and value of the native grasses and forage plants, as well as the peculiar conditions of soil and climate best suited to their growth. More than 500 varieties of grasses and forage plants valued for forage have been grown in the grass garden on the grounds of the Department during the past season.

Over 5000 specimens of American grasses have been identified during the year, and nearly 3000 sheets of herbarium specimens mounted and added to the National Herbarium. The grass collection now in the Department numbers over 30,000 sheets.

Soils.

Records have been continued of the moisture content of some of the principal soil areas in the country with the electrical method of moisture determination. As the soil is the immediate source of the water supply of plants, this record becomes an essential part of climatology, and it seems probable that this work of the Division of Soils, in connection with the present work of the Weather Bureau and of the Division of Statistics, will develop a distinctively new line of agricultural climatology. This work is closely related to the work of the Weather Bureau, but is supplementary to it. It includes the record of evaporation to which the plant is subjected, the water supply maintained by the soil for supplying the loss due to this evaporation, and the intensity of the actinic and heat radiations which influence the physiological activities of the plant. Numerical values can be given to the evaporation and to the soil-moisture conditions, so that it is possible to express numerically the relative conditions of plant growth from day to day so far as these two important factors of evaporation and water supply are concerned. This will add greatly to the practical value of our knowledge of climatology.

Among the most important lines of work which the Department can take up for the tobacco grower is the study of the diseases in the tobacco bed and the comparatively few diseases in the field, and particularly the study of curing and fermentation. A large amount of research work has been done, particularly in Germany, in the fermentation of tobacco, but very little is yet known of the changes which go on in the process or regarding the specific agents which bring about these changes. So much information and practical benefit have been derived from a study of butter and cheese, in the control of the ferments and bacteria which produce the texture and flavour of the product, that it is very desirable that similar knowledge in the curing and fermentation of tobacco, and similar control of the finished product, should be secured. This work will require very careful study of the changes in the fermentation pile in the different tobacco districts.

If American tobacco growers are to attempt to raise a product equal to that of Cuba and Sumatra, and if this is to be done not by chance, but through systematic, scientific investigations, then the soils and other conditions of growth must be thoroughly understood, and the fermentation changes carefully worked out in Cuba and Sumatra. It is necessary, therefore, that a soil expert and a bacteriologist extend their work to these foreign countries.

Botany.

The Division of Botany is at work to reduce the importations into the United States of the little things that have been costing the Americans 8,000,000 dollars annually. Western States are now growing chicory. In 1896 16,317,888 pounds were imported, in 1898 only 315,707 pounds of raw chicory were imported. The farmers of Michigan, Nebraska, and other States will now furnish the supply. Ginseng is also a promising plant for cultivation. The Division of Botany will make tests to protect farmers and merchants against foul and fraudulently imported seeds, and test the importations of the Department before distribution.

The distribution of young plants to various parts of the country was continued during the year, reaching a total of nearly 190,000, including bulbs. Among these were olive, fig, and camphor plants and cuttings. Attention is called to the fact that the growing of rubber plants, even in the most favourable localities of Florida, can hardly be commercially successful.

Experiment Stations.

The annual grant of 720,000 dollars for the agricultural experiment stations is supplemented by 400,000 dollars from the States. About four hundred reports and bulletins were issued by the stations in 1897, which were directly distributed to over half a million addresses.

The need and value of scientific researches on behalf of agriculture are now very clearly understood, and the number and importance of institutions organised for this work are constantly increasing in all parts of the world. Nowhere has so

comprehensive and efficient a system of experiment stations been established as in the United States. In the scope and amount of their operations, and in the thoroughness with which the useful information they obtain is disseminated among the farmers, the stations are unsurpassed.

The stations are not the only means for the education of the farmer. Agricultural colleges, farmers' institutes, boards of agriculture, and various other agencies have been established to instruct the farmer regarding the present status of agricultural science as applied to his art. It is the business of the experiment stations, on the other hand, to advance knowledge of the facts and principles underlying successful agriculture, and to teach the farmer new truths made known by their investigations. The act of Congress creating the stations clearly defines their functions to be the making and publishing of original investigations. Wherever a station has neglected this, and merely endeavoured to educate the farmer, we find a weak station, and wherever a station has earnestly devoted itself to original investigations, we find a strong station. The station may very properly lend its influence to strengthening the influence and work of the educational agencies established for the farmers' benefit, but it fails to fulfil its real mission when it resolves itself into a bureau of information, or devotes a large share of its energies to the compilation of popular treatises on agriculture. It is gratifying to observe that the original investigations at the stations are increasing in number and improving in quality.

The movement for the extension and popularisation of agricultural instruction is growing in importance. The short and special courses in the colleges, the farmers' institutes, and the home-reading circles are attracting larger numbers of farmer students. The effort to introduce nature teaching, largely on subjects relating to agriculture, is being actively prosecuted in several States.

The investigations upon the "nutritive value of various articles and commodities used for human food" have been pursued as hitherto, in co-operation with agricultural colleges and experiment stations and other educational institutions. Special investigations with the respiration calorimeter have been made, in which not only the nutritive value of the food consumed but also its relation to the heat and energy evolved by the human body during periods of rest and work have been measured with a completeness and accuracy hitherto unknown. These investigations are not only of very high scientific importance, but have also already given promise of useful practical application. The results of the careful studies of the dietaries of people of different occupations, made in connection with the nutrition investigations, have been widely republished.

It is believed that the nutrition investigations of the Department have already done much to establish a scientific basis for the courses of instruction on the food and nutrition of man, which are rapidly increasing in number and importance throughout the country.

Practical Experiments in Nature Teaching under State Authority.

In New York, the College of Agriculture of Cornell University has a special State grant of 25,000 dollars per annum to be used in aiding the introduction of nature teaching into the common schools and the carrying on of simple agricultural experiments in different parts of the State. The plan followed has been to employ experts in the different sciences to prepare brief leaflets containing lessons on various subjects for the use of teachers in the common schools. These leaflets are distributed to teachers throughout the State, and there has been such a large demand for them from teachers in other States that arrangements have been made to sell them at a nominal price.

The professors and other agents of the university attend meetings of teachers from time to time, to explain the scope of this work and to show the teachers how to carry out simple instruction on nature topics. Many of these leaflets relate directly to agricultural subjects. For example, in one leaflet the teacher is instructed to have the children plant squash seeds, take some of them up at intervals to learn how the seeds germinate, and watch what happens to the little plants as they grow. At another time the children are encouraged to plant little gardens and carefully watch some of the things that grow in them; or they study some insect which preys upon fruit, or make collections of the insects about their homes, or watch them to see whether they are doing things good or bad for the farmer. This movement has rapidly increased in popularity, and the leaflets are used in many city schools as well as in those in the country. Hundreds of simple experiments with fertilisers on potatoes have been carried on in different parts of the State with some of the money above referred to. For carrying on all this work the university has employed its teaching force and a small corps of special agents and clerks.

In Indiana, Purdue University has undertaken a similar work, though its funds have not permitted it to make it very extensive. A number of leaflets have been prepared by different members of the faculty, and have been sent out to teachers throughout the State. In a number of other States nature teaching has been introduced into the common schools, but for the most part in the schools in the larger towns and cities, where there were teachers who had had some training in natural science. As a result of the widespread interest in this subject, teachers' manuals and text-books for instruction in this branch are being prepared.

Animal Diseases.

The Bureau has continued experimentation with antitoxin serum for the prevention and cure of hog cholera. Congress, at its last session, made a grant in aid of this work, which became available at the beginning of the present fiscal year. Buildings were erected at an experiment station, and animals purchased to make the serum in sufficient quantities to conduct extensive research. The results of the previous year have been corroborated. Eighty per cent. of the animals treated were saved, while a like per cent. of the check herds not treated died. This justifies the Department in efforts to supply in future to herdsmen throughout the country such serum as can be made. It is for Congress to determine whether serum shall be given free or a charge be made covering the expense of manufacture, which would be about fifteen cents for each animal.

The study of tuberculosis, with reference to both men and animals, has been continued, and the results so far obtained indicate that experiments already begun in this line should be continued, as there is a prospect of more satisfactory results.

Experiments in dipping cattle to kill the ticks which cause Texas fever were continued, with the gratifying result that a substance has been found which will destroy all the ticks on an animal at a single dipping, and will not injure the animal.

Chemistry.

The Division of Chemistry during the past year has continued its work on the composition and adulteration of foods. An elaborate bulletin, treating of the composition of cereals and all cereal products, represents the results of the principal amount of work in this direction. Another bulletin is devoted to the composition and uses of Indian corn, and this bulletin was prepared especially for presentation at the third International Congress of Applied Chemistry in Vienna, which met in July 1898.

The Division continued during the year its investigations of the possibilities of producing high-grade sugar beets in various parts of the United States. As a result of the extensive chemical studies conducted, the area suitable to the production of the best beets has been more definitely delineated. A few years more of studies of this kind will mark out in a practical manner the areas where beets of the highest grade can be produced.

Entomology.

General investigations have been carried on in this Division through the year upon insects injurious to garden crops, to shade trees, and to citrus trees and fruit. The general experimental work, with remedies, has comprised especially careful investigations of the availability of hydrocyanic acid gas in the disinfection of seeds in bulk and of plants and nursery material, and further experiments with arsenicals and various oil mixtures in order to determine their effects on plants in dormant condition and in foliage.

A preliminary attempt has been made to introduce from Southern Europe into California an insect which is responsible for the fertilisation of the Smyrna figs of commerce. The Entomologist visited California in the spring of 1898, and found that conditions were ripe for such an attempted introduction, and an agent in Europe will, during the coming year, endeavour to take the necessary steps to bring about this introduction, which, it is hoped, will result in the production by California of a fig equal to the Smyrna fig.

A successful importation has been made of an important parasite of certain large scale insects.

Other important work carried on under this Division during the year has included the sending successfully of beneficial species to foreign Governments suffering from outbreaks of the white or fluted scale, the preparation of an account of the work accomplished during the past two years against the San José scale, an investigation of the injurious grasshoppers of the Western States, work upon remedies to be used against the house fly, suggested by the growing belief in the importance of this insect as a carrier of disease; work upon the geographic distribution of injurious insects of the United States, and experimental work in agriculture.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Board of Electors will meet on February 11 for the purpose of electing a successor to the late Professor of Pathology, Dr. Kanthack. Candidates are to send their names to the Vice-Chancellor on or before February 4.

The Clerk Maxwell Studentship in Experimental Physics has been awarded to Mr. J. S. E. Townsend, of Trinity College.

AT a meeting in Birmingham, last week, of the Court of Governors of Mason University College, Mr. Chamberlain, in his capacity of president of the College, occupied the chair. In the course of his remarks, Mr. Chamberlain mentioned that the endowment fund of the proposed University of Birmingham had made very considerable progress, and that further assistance was to be expected from the leading managers and directors of the great limited liability firms, who were inclined to take a proper view of their responsibilities and obligations in a question upon which the future of the city so largely depended. Referring in more detail to the University scheme, Mr. Chamberlain emphasised the importance of establishing a faculty of commerce in connection with the curriculum. "Whilst," he remarked, "we shall always hope that in the University the highest culture will receive its due attention, still I think it important, to justify our separate existence, that we should have distinctive features in our curriculum, and nowhere shall we find that better than in such a faculty of commerce." Mr. Chamberlain's ambition is that in the future the business men of Birmingham and the district who enjoy a fair social position will not consider themselves properly equipped for their career without having obtained a degree in the University faculty of commerce.

THE annual meeting of the Geographical Association was held on Wednesday, January 11. As already stated (p. 238), the Association was founded in 1893, and its aim is to raise geography as a school subject from its present low level in secondary schools by spreading the knowledge of all such methods of geographical teaching as bring into play the pupil's intelligence and reasoning powers, instead of merely loading the memory with names and isolated facts. A memorial to boards of public examiners on the subject of reforms in examinations in geography has already, in many cases, led to a marked improvement in the character of the questions set. Amongst other means adopted by the Association for the furtherance of its aim, are lectures and meetings for discussion; the adoption of the *Journal of School Geography* as a medium for the publication of information of service to teachers of geography; and the circulation of lantern slides (maps, diagrams, and views of scenery). The question of a syllabus has been before the Association for some time, but the Committee are unwilling to lend their authority to any definite scheme of work, preferring rather to encourage individual teachers to explain in detail their own ideas of method, the outcome of their own practical experience. Mr. Douglas W. Freshfield, the president of the Association, delivered a short address at the annual meeting, and in the course of his remarks he referred to points dealt with in the report, and commended the decision of the Committee in not insisting upon any particular form of syllabus.

A CONFERENCE on science teaching in connection with the Technical Education Board of the London County Council was held, under the direction of Dr. Kimmins, at the South-West London Polytechnic, on January 12 and 13. The following papers occupied the morning of January 12:—"The Teaching of Optics," by Mr. Sanderson, headmaster of Oundle School; "The Method of Teaching Science," by Mr. Frank Weedon, of Alleyn's School, Dulwich. Dr. Garnett presided. In the afternoon Miss Edna Walter, of the Central Foundation School for Girls, and Mr. Burkhardt, of Owen's School, Islington, read papers on "The Teaching of Chemistry." Prof. Armstrong occupied the chair. At the third meeting Mr. S. H. Wells, Principal of the Battersea Polytechnic, and Mr. S. Whalley, of Simon Langton School, Canterbury, read papers on "The Teaching of Elementary Mechanics in Schools." Prof. Hudson Beare presided. At the fourth meeting, papers on "The Teaching of Heat," by Mr. Arthur Adamson, of the Central Higher Grade School, Manchester; and on "Magnetism and Static Electricity," by Dr. T. Buchanan, of Gordon College, Aberdeen, took up the attention of the meeting. Prof. Ewing presided. It is much to be hoped that this very successful experiment will be repeated next year. The attendance at each meeting was large, and included, in addition to many science teachers from all parts of the country, several of the inspectors of the Science and Art Department, and such well-known men of science as Dr. Gladstone and Captain Abney. Enthusiastic discussions followed each paper, and the number of practical hints which were to be gleaned at each meeting well repaid attendance. The collection of apparatus, specially designed for use in schools, which Dr. Kimmins had got together and had arranged in the physical, chemical and mechanical laboratories, should do a great deal in the direction of acquainting science masters with what other teachers are doing. Many of the exhibits were original, and highly ingenious.

AT a meeting of Convocation of the University of London, held on Monday, it was resolved:—"That, in the opinion of this house, the new regulations for the matriculation examination tend to discourage the study of modern languages in schools, by making them entirely optional and alternative to science." The following resolution was referred to the standing committee:—"That the examination in general elementary science should be restricted to the first part of the subject, and comprised in one paper; the second part to be made optional with the other sciences, and a third language to form a separate and obligatory section taking its place."

AT the annual general meeting of the Headmasters' Association, on Friday last, the following resolutions were adopted: (1) "That this Association cordially welcomes the Board of Education Bill as a first step towards the organisation of secondary education in England, and is of opinion that the consultative committee proposed therein ought to be permanent and to contain representatives of the Universities and of bodies of teachers." (2) "That this Association records with satisfaction the statement made by the Lord President in introducing the Board of Education Bill—viz. that the proposed Education Office would probably be so organised as to consist of three departments, dealing with primary, secondary, and technical education respectively."

THE Association of Technical Institutions held its annual conference in London on Thursday last. Lord Spencer was elected president for the ensuing year, and delivered an address, on which he dwelt on the extreme importance of improved technical education in the interests of our commerce and industry, and indicated some of the more pressing reforms that were needed. The following resolution was afterwards carried:—"That the Association desires to place on record its appreciation of the Board of Education Bill, 1898, as a first instalment of legislation on the lines recommended by the recent Royal Commission, and its hope that the Government may see its way to proceed further in the same direction."

THE Association of Directors and Organising Secretaries for technical and secondary education held its annual meeting on Friday last, Mr. H. Macan presiding. The chief subject discussed was the Government Secondary Education Bill, and the constitution of the proposed local authority to be responsible for technical and secondary education. It has already been agreed among the bodies interested that on the new local education authorities the County Council should have half the representation, and the School Boards a third, the remainder being made up of co-opted members. At Friday's meeting, some hostility was shown towards the proposal to give School Boards so large a representation as a third, or even any at all, the opinion being expressed that the present powers possessed by County Councils are sufficient to secure the representation of all educational interests in the areas of administrative counties. Among the resolutions agreed to was one expressing the view

that, in the opinion of this Association, it was both undesirable and impracticable to draw any line of separation between secondary and technical education in any legislation concerning central or local authorities, and another to the effect that in no case should a permanent consultative committee be attached to the Board of Education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 15, 1898.—"The Action of Magnetised Electrodes upon Electrical Discharge Phenomena in Rarefied Gases." Preliminary Note. By C. E. S. Phillips. Communicated by Sir William Crookes, F.R.S.

The experiments described in this paper were undertaken in order to study, more especially, the action of magnetised electrodes upon the phosphorescent afterglow which is often seen to illuminate the inner surface of the glass walls of vacuum tubes when an electrical discharge has passed within them.

The apparatus employed consisted of a glass bulb, nearly spherical in shape and about 2½ inches in diameter, open at both ends, for the purpose of inserting and sealing into position, two soft iron electrodes, so placed that their pointed ends were within 1/16 inch of one another.

Each electrode had a screw-thread of suitable pitch cut upon it in order that two brass cups, when screwed into position and sealed with cement to the glass, might serve to keep the electrodes central, to reduce the possibility of their rushing together under the influence of strong magnetic forces, and to seal air-tight the two ends of the bulb.

Suitable arrangements having been made for strongly magnetising the electrodes by means of a powerful external electro-magnet, the bulb was then connected to a Sprengel air-pump and slowly exhausted. During this process the usual luminous phenomena were observed whenever a discharge was passed through the bulb; while on magnetising the electrodes the results obtained were, in some cases, very remarkable

A rarefaction having been obtained such that a three-inch spark from a ten-inch Apps induction coil could scarcely start the glow, it was observed that, after a strong stimulation of the bulb had taken place and then been stopped (the electrodes meanwhile remaining unmagnetised), on exciting the magnet a luminous ring suddenly appeared within the bulb, between the pointed ends of the electrodes, and in a plane at right angles to the direction of the magnetic lines of force. It shone brightly for a moment, when the magnet circuit was "made," and it was more sharply defined at high exhaustions—becoming, in fact, hazy and indefinite if the pressure within the bulb were slightly increased. Even with the connecting wires between the coil and the bulb completely removed after stimulation, the ring formed as well as ever when the magnet was turned on. At the moment the ring appeared within the bulb the glass walls became electrically charged so strongly that, in some cases, a spark could be seen to pass between the glass and either of the exposed ends of the electrodes at the moment the magnet was excited. It was further noticed that the ring was in rapid rotation and also very sensitive to variations in the electrical charges, upon the bulb.

Under certain conditions a second ring formed concentrically with the first. Experiments were also made with external magnetic electrodes, and irregular green splashes and puffs of white cloudy light appeared in the interior of the exhausted vessel when the electrodes were magnetised.

Geological Society, January 4.—W. Whitaker, F.R.S., President, in the chair.—Capt. A. W. Stiffe exhibited a fossil *Cardium* (?) from the beach at the foot of the cliffs of Ormara (Makran Coast).—"Geology of the Ashbourne and Buxton Branch of the London and North-Western Railway: Ashbourne to Crake Low," by H. H. Arnold-Bemrose. The southern part of the new railway from Ashbourne, through Tissington and Crake Low to Buxton, exhibits several sections in Trias, Boulder Clay, Mountain Limestone, and Yoredale Beds. Interstratified with the latter is a thick bed of volcanic ash, with thinner intercalations of tuff. Within a mile of Tissington ash is exhibited four times in the cuttings, and according to the view of the author it is the same bed repeated by basins and domes, one of the latter of which is faulted. While the rocks succeeding the ash in some places are limestones, cherts, and shales of Yoredale type, in one section they resemble more closely the upper beds of the Mountain Limestone. The limestones are often dolomitised.—"The Oceanic Deposits of Trinidad," by Prof. J. B. Harrison and A. J. Jukes-Browne. The object of this communication was to present some observations on the succession and geological relations of the beds which have long been known in Trinidad as the Naparima Marls. In his historical introduction Mr. Jukes-Browne deals with the writings of Mr. Guppy and Prof. Harrison, and shows that three definite issues are thus raised: (1) Are the Nariva Beds above or below the Naparima Marls? (2) Do the *Globigerina*-marls occur in the Naparima district, and, if so, are they connected with the Radiolarian marls, or are they part of a separate formation? (3) What is the relation between the San Fernando Beds and the other groups? Mr. Guppy and Prof. Harrison agree in answering the first part of the second question in the affirmative, and in stating that the two marls are closely connected together. It appears that the *Globigerina*-marls occupy the place of the basal chalks of Barbados, but are much thicker, while the radiolarian rocks are thinner, and the interbedded volcanic ashes so frequent in Barbados are wanting in Trinidad. Chemical and microscopic analysis of the *Globigerina* and radiolarian beds are given, and, compared with similar analyses of the Barbadian deposits, they show that more quartz and argillaceous matter occur in Trinidad. The following correlation is proposed:—

Barbados.	Trinidad.	
Coral Rocks. } Bissex Beds. }	Moruga Series.	Pleistocene and Pliocene.
Oceanic Beds.	Naparima Marls.	Miocene.
Scotland Beds. Upper. Lower.	San Fernando Beds. Nariva Series.	Oligocene and Eocene.

The Oligocene and Eocene Beds are of shallow-water origin, and seem to be unconformably covered by the Naparima Marls.

PARIS.

Academy of Sciences, January 9.—M. van Tieghem in the chair.—On the hysteresimeter constructed by MM. Blondel and Carpentier, by M. Marcel Deprez. The author describes an instrument for the measurement of hysteresis, constructed by him about four years ago for the *Conservatoire National des Arts et Métiers*, the principle of which is identical with that of the hysteresimeter recently invented by MM. Blondel and Carpentier, the only differences being that the author's instrument was of dimensions suitable for measuring the hysteresis of iron rings of the size actually used in dynamos, and contained an electro-magnet instead of a permanent magnet.—The cryoscopy of urine, by M. Ch. Bouchard. From the observed depression of the freezing point of urine, suitably diluted if necessary, the depression due to sodium chloride present is subtracted, and the mean molecular weight of the rest of the solid matter determined in the usual manner. In a man in a normal state of health the value of this mean molecular weight is about 62, rarely falling below 60, or rising above 68. In disease the value of this constant is usually raised, varying from 68 to 112.—Histology of the skin. Definition and nomenclature of the epidermal layers in man and mammals, by M. L. Ranvier. Seven distinct layers are described as existing in the epidermis of man and mammals, each layer being characterised by perfectly clear physical characters and chemical reactions. The names given to these strata are: *Germinativum*, *filamentosum*, *granulosum*, *intermedium*, *lucidum*, *corneum*, and *disjunctum*.—Observations of the total eclipse of the moon of December 27-28, made at the Observatory of Bordeaux, made by MM. G. Rayet, E. Doublet, and F. Courty, by M. G. Rayet.—Report on a memoir of M. Partiot on the choice of a velocity formula.—Generalisation of the analytical prolongation of a function, by M. Eugène Fabry.—On the singular points of a function defined by a Taylor's series, by M. Servant.—On the correspondence between right lines and spheres, by M. E. O. Lovett.—On the bending of a cylinder with circular base, by M. Ribière.—On the experiment of Lord Kelvin and Joule, by M. A. Leduc.—On the variations of resistance of an electrolytic conductor in a magnetic field, by M. H. Bagard. The author has succeeded in showing that the resistance of a solution of copper sulphate, suddenly placed in a magnetic field of about 5000 C.G.S. units, undergoes an increase of about one per cent. its original value.—On the absolute value of the magnetic elements on January 1, 1899, by M. Th. Moureaux.—On the preparation and properties of calcium arsenide, by M. P. Lebeau. This

substance can be obtained in a state of purity in two ways, by the interaction of calcium and arsenic at a low red heat, and by heating carbon and calcium arsenate in the electric furnace. The arsenide has the composition $Ca_3 As_2$, and is readily decomposed by water giving pure $As H_3$, mixed, however, with a little acetylene when the product from the electric furnace is used. It is readily attacked by the halogens, but is unaltered in dry air or oxygen.—On the decomposition of carbon monoxide in presence of ferric oxide, by M. O. Boudouard. The decomposition is a function of the time, and also depends upon the quantity of oxide of iron present.—Volumetric estimation of cerium, by M. André Job. Ceric salts can be accurately determined in acid solution by titrating with aqueous hydrogen peroxide, the end of the reaction being indicated by the disappearance of the yellow coloration. An estimation of the cerium contained in the crude mixture of oxalates from monazite can be carried out in a few minutes by this method.—The variation of entropy in the dissociation of similar heterogeneous systems, by M. Camille Matignon. From the measurements of MM. Isambert and Bonnefoi of the heats of combination and the temperatures at which the dissociation pressure reaches 760 mm., it is shown that these quantities are proportional in the case of compounds of the type Ca Cl2 $4NH_3$. This result is expressed by the statement that when similar systems dissociate with the same dissociation pressure, the variation of entropy is the same.—Constitution and chemical properties of ethylideneimine, by M. Marcel Delépine. The constitution ethylideneimine $(CH_3 CH=NH)_3$, is assigend to aldehyde ammonia, and it is shown that all the reactions of this compound agree well with the formula.—Derivatives of synthetic methyl-heptenone, by M. Georges Leser.—Synthesis of dimethyl-heptenol, by M. Ph. Barbier. This synthesis is easily effected from methyl-heptenol and methyl-iodide, by a modification of Saytzeff's method, using magnesium instead of zinc.—Studies on filtration, by M. J. Hausser.—On a mode of formation of ureas, by M. A Jouve. If a solution of carbon monoxide in ammoniacal cuprous chloride is heated under pressure at 105°, urea is formed. The substitution of fatty and aromatic amines for the ammonia gives the analogous substituted ureas.—On an absinthine, a new substance extracted from absinthe, by MM. Adrian and A. Trillat.—On the formation of sugar from egg albumen, by M. Ferdinand Blumenthal. By the action of baryta water upon white of egg, a sugar is obtained giving a phenyl-glycosazone on treatment with phenyl-hydrazine.—Modifications undergone by toxins when introduced into the digestive tube, by MM. Charrin and Levaditi.—The sexual law of the smallest coefficient, by M. F. Le Dantic.—On the culture of monstrosities in plants, by M. Hugo de Vries.—The leucite volcanic rocks of Trebizonde, by M. A. Lacroix.—On the laws governing macles properly so called, by M. Fred. Wallerant.—On the conditions of culture in Tunis, by M. J. Dybowski.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—Observations upon the Normal and Pathological Histology and Bacteriology of the Oyster: Prof. Herdman, F.R.S., and Prof. R. Boyce.—On the Formation of Multiple Images in the Normal Eye: S. Bidwell, F.R.S.—On the Vibrations in the Field round a Theoretical Hertzian Oscillator: Prof. K. Pearson, F.R.S., and Miss Lee.—On the Refractive Indices and Densities of Normal and Semi-normal Aqueous Solutions of Hydrogen Chloride, and the Chlorides of the Alkalies: Sir J. Conroy, F.R.S.

ROYAL INSTITUTION, at 3.—Tibet and the Tibetans: A. H. Savage Landor.

SOCIETY OF ARTS (Indian Section), at 4.30.—Railways in Burma, and their proposed Extension across Yunnan: J. Nisbet.

LINNEAN SOCIETY, at 8.—New Peridiniaceæ from the Atlantic: G. R. Murray, F.R.S., and Miss F. G. Whitting.—On the Structure of Lepidostrobus: Arthur J. Maslen.—Some Observations on the Caudal Diplospondyly of Sharks: Dr. W. G. Ridewood.

CHEMICAL SOCIETY, at 8.—Researches on Moorland Waters I. Acidity: W. Ackroyd.—α-ketotetrahydronaphthalene: Prof. F. S. Kipping, F.R.S., and Alfred Hill.—A New Method for preparing *as*-dimethyl- and Trimethyl-succinic Acids: William A. Bone.—Reduction of Optically-active Mono- and Di-alkyloxysuccinic Acids from Malic and Tartaric Acids: Prof. Thomas Purdie, F.R.S., and William Pitheathly.—Action of Ammonia on Ethereal Salts of Organic Bases: Dr. Siegfried Ruhemann.—Esterification Constants of Substituted Acetic Acids: Dr. J. J. Sudborough and Lorenzo L. Lloyd.—Di-ortho-substituted Benzoic Acids. Part IV. Formation of Salts from Di-ortho-substituted Benzoic Acids and different Organic Bases: Lorenzo L. Lloyd and Dr. J. J. Sudborough.—The Thermal Effects of Dilution: J. Holmes Pollok.—The Changes of Volume due to Dilution of Aqueous Solutions: F. B. H. Wade

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—Liquid Hydrogen: Prof. J. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Epidemic Cerebro-spinal Meningitis: Dr. Bruce Low.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, JANUARY 21.

MATHEMATICAL ASSOCIATION, at 2.—Annual Meeting.—On the Expression "Motion at an Instant": S. A. Saunder.—Porismatic Equations: R. F. Davis.—Arithmetical Division: E. M. Langley.

MONDAY, JANUARY 23.

SOCIETY OF ARTS, at 8.—Bacterial Purification of Sewage: Dr. Samuel Rideal.

IMPERIAL INSTITUTE, at 8.30.—The Work and Wealth of Western Australia: E. T. Scammell.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Plan of the Earth, and its Causes: Dr. J. W. Gregory.

TUESDAY, JANUARY 24.

SOCIETY OF ARTS (Foreign and Colonial Section), at 4.30.—Rhodesia and its Mines: W. Fischer Wilkinson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Effects of Wear upon Steel Rails: William G. Kirkaldy.—On the Microphotography of Steel Rails: Sir William Roberts-Austen, K.C.B., F.R.S.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The Development of Gelatino-chloride Papers: John Sterry.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Anniversary Meeting.

WEDNESDAY, JANUARY 25.

SOCIETY OF ARTS, at 8.—Tuberculosis in Animals: W. Hunting.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Contributions to the Theory of Simultaneous Partial Differential Equations: Prof. A. C. Dixon.—On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks. III. On *Medullosa anglica*, a New Representative of the Cycadofilices: Dr. Scott, F.R.S.—On the Nature of Electro-Capillary Phenomena. I. Their Relation to the Potential Differences between Solutions: S. W. F. Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Rules for the Regulation of the Wiring of Premises for Connection to Public Supply Mains: J. Pigg.—The Regulation of Wiring Rules: C. H. Wardingham.—The Institution Wiring Rules: R. E. Crompton.

CONTENTS.

	PAGE
The Anatomy of the Earth's Crust	265
The Oasis of Siwah	266
An Italian Text-Book of Physiological Chemistry. By S. L.	267
Our Book Shelf:—	
Allen: "Flashlights on Nature."—L. C. M.	268
Lane: "Spherical Trigonometry (Theoretical and Practical)"	268
Letters to the Editor:—	
The Duke of Argyll and Mr. Herbert Spencer.—Prof. R. Meldola, F.R.S.	269
The late Prof. George James Allman, as a Botanist.—Prof. George J. Allman, F.R.S.; Prof. G. B. Howes, F.R.S.	269
The Density of the Matter composing the Kathode Rays.—W. B. Morton	270
Attraction in a Spherical Hollow. (*With Diagram.*)—Prof. Thos. Alexander	270
Fourier's Series.—R. B. Hayward, F.R.S.	271
The Decrease of Swallows and Martins.—J. Herbert Allchin	271
Fossil Vertebrates in the American Museum of Natural History. (*Illustrated.*) By Prof. Henry F. Osborn	272
Notes	275
Our Astronomical Column:—	
Comet Chase	279
Velocity in the Line of Sight of η Pegasi	279
The Leonids in 1898	279
New Instrument for Measuring Astrographic Plates	279
The Spectrum of the Corona. (*Illustrated.*) By Sir Norman Lockyer, K.C.B., F.R.S.	279
High Vacua produced by Liquid Hydrogen. (*Illustrated.*) By Prof. James Dewar, F.R.S.	280
Geology of South-Western Nova Scotia. (*Illustrated.*)	283
Scientific Work of the U.S. Department of Agriculture	283
University and Educational Intelligence	286
Societies and Academies. (*Illustrated.*)	287
Diary of Societies	288